IIPOWERS

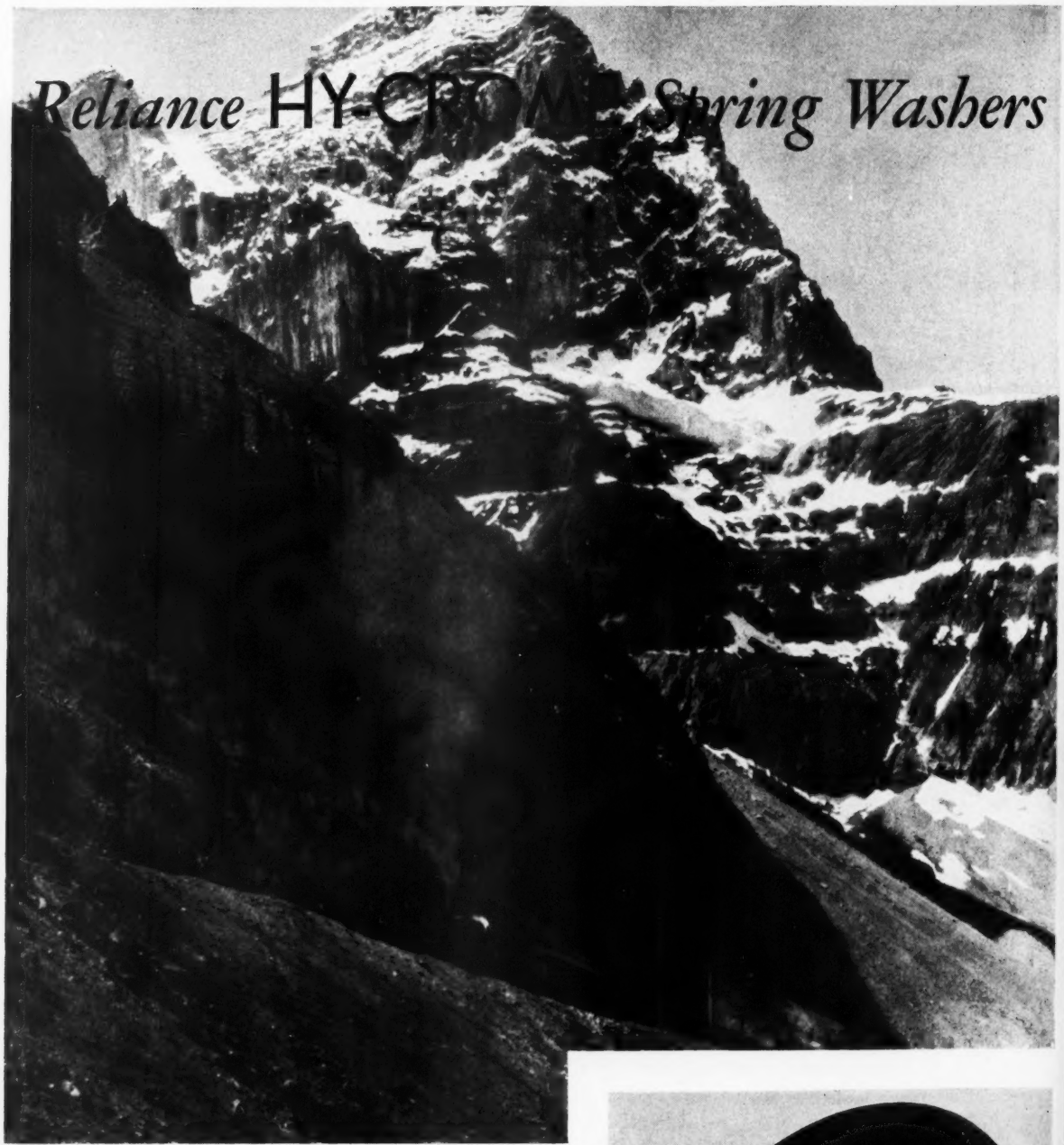
IMPROVED HIPOWER

SAVES WEAR—
SAVES MAINTENANCE—
SAVES MILLIONS for
the great Railroads
of the Country....

BEFORE ORDERING CONSULT
OUR ENGINEERING AND
SALES DEPARTMENTS

NATIONAL LOCK WASHER COMPANY
NEWARK, NEW JERSEY

Reliance HY-CROME Spring Washers



CANADIAN PACIFIC TRANSCONTINENTAL ONE OF AMERICA'S FAMOUS TRAINS

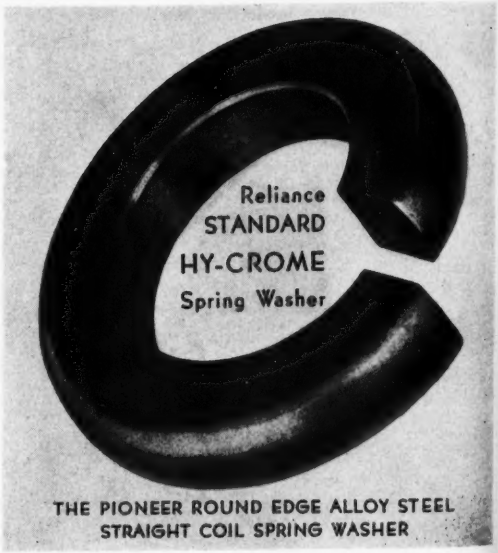
RAILROAD operations in western Canada abound with difficulties, and here is the Canadian Pacific *Transcontinental* coming out of the famous Spiral Tunnels—the building of which required two years and over a million dollars. Tunnels comprise several spirals and eliminate dangers of landslides or avalanches. The distance is shortened by four miles and the use of the tunnels lowers the summit attained by the railway by 552 feet. On the slope in the foreground, just below the train, is the entrance to the up-grade tunnel from the upper end of which the *Transcontinental* is emerging. Mount Stephen is seen, snow-covered, in the background. Along such railways extreme diligence in track maintenance is a necessity—and The CANADIAN PACIFIC RAILWAY in years past has been a large purchaser of HY-CROME *Spring Washers*.

EATON MANUFACTURING COMPANY

RELIANCE SPRING WASHER DIVISION

MASSILLON, OHIO

Sales Offices: New York, Cleveland, Detroit, Chicago, St. Louis, San Francisco, Montreal



THE PIONEER ROUND EDGE ALLOY STEEL STRAIGHT COIL SPRING WASHER

Published monthly by Simmons-Boardman Publishing Company, 105 W. Adams St., Chicago, Ill. Subscription price, United States and Possessions, $2.00; Canada, $2.50; Foreign, $3.00. Single copies 35 cents. Entered as second class matter January 20, 1933, at the postoffice at Chicago, Illinois, under the act of March 3, 1879, with additional entry at Mt. Morris, Ill., postoffice. Address communications to 105 W. Adams St., Chicago, Ill.

200,000,000
LUNDIE TIE PLATES IN SERVICE

Prove Their Economic Value

WHEREVER Lundie Tie Plates are in use—the service rendered has been conspicuously outstanding. The Lundie performs all the functions of the ideal tie plate without resorting to means which are detrimental and destructive to ties.

Lundie tie plate service is superior because:

It prevents the widening of track
The plate does not slip or kick out
No tie destroying projections are needed
The plate seats itself perfectly
It gives proper inclination to rail
It protects ties against mechanical wear
Does not cut a single tie fibre.

The reason: The Lundie bottom consists of multiple bearing areas, with each surface normal to the resultant of the vertical and lateral loads on the tie.

It is the only essentially flat bottom tie plate that holds gauge.

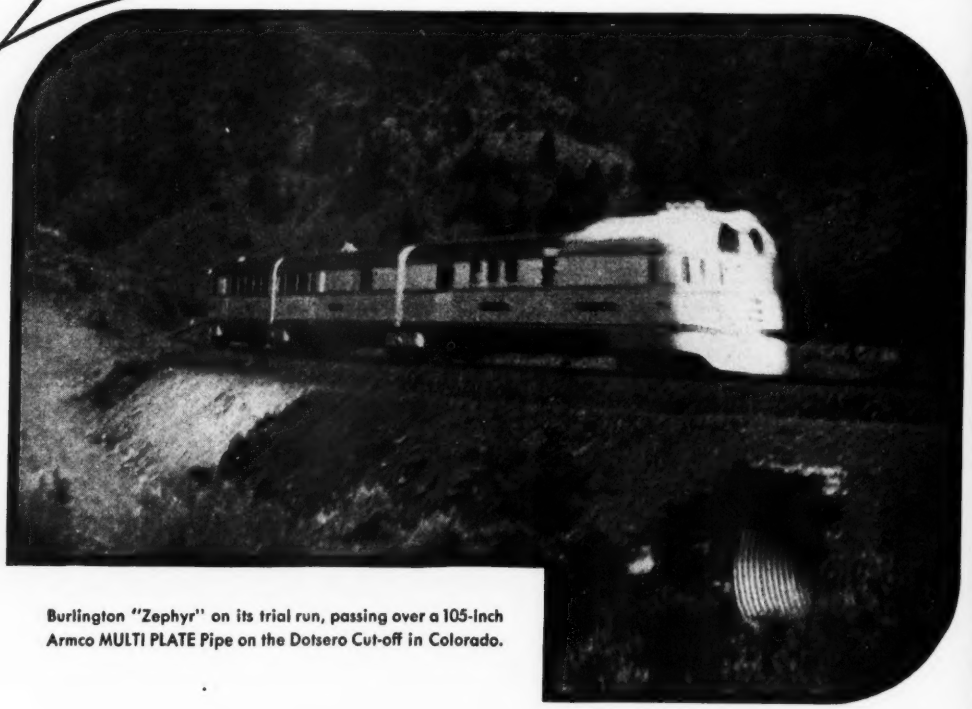
THE LUNDIE ENGINEERING CORPORATION

Tie Plates—Ardco Rail and Flange Lubricator

285 Madison Avenue, New York 59 E. Van Buren St., Chicago

LUNDIE TIE PLATE

AS MODERN AS THE "Zephyr"



Burlington "Zephyr" on its trial run, passing over a 105-Inch Armco MULTI PLATE Pipe on the Dotsero Cut-off in Colorado.

MODERN in every respect is the Burlington's outstanding train—the "Zephyr." But none the less modern is this portion of the roadbed on the new Dotsero Cut-off in Colorado—with a drainage installation of Armco MULTI PLATE Pipe.

This up-to-date drainage structure, (available also in arch form), was delivered to the job "knocked down," where it was quickly assembled by the contractor—entirely eliminating delay to construction operations. The thick iron plates are deeply corrugated, thus giving adequate strength for the heaviest of loads. And being made of rust-resisting Armco Ingot Iron, they will last for many decades. Should traffic conditions require extending or salvaging the pipe, either can readily be done at reasonable cost.

Ask the Armco engineer about it, or write for complete descriptive data on this modern drainage product.

INGOT IRON RAILWAY PRODUCTS COMPANY

Middletown, Ohio • Berkeley, Calif.

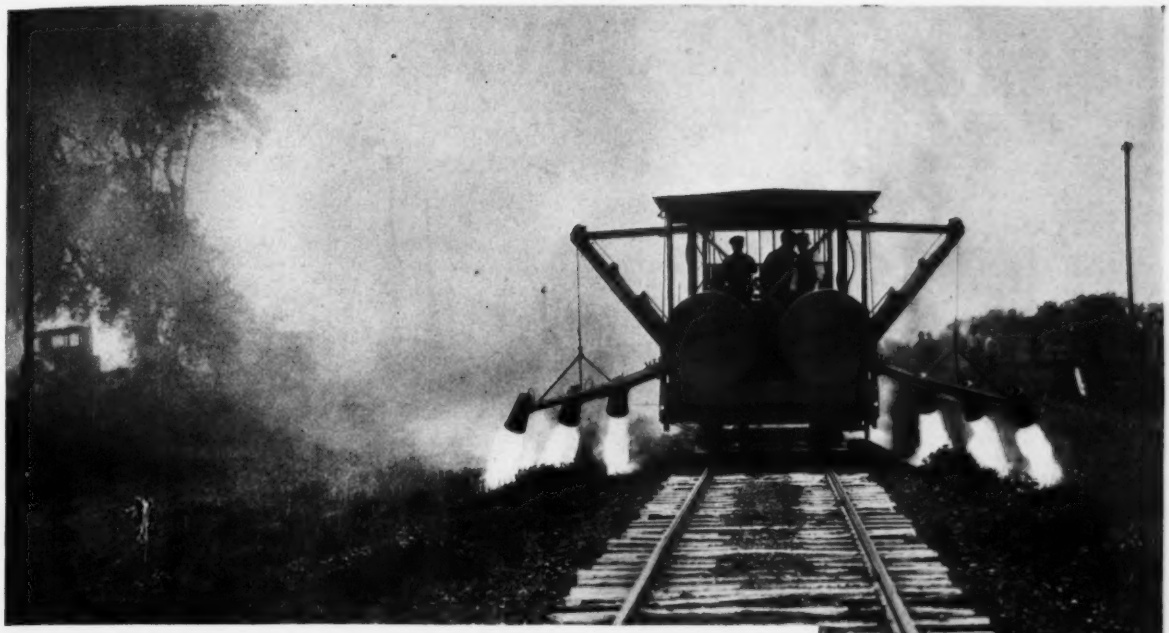
(Member of the Armco Culvert Mfrs. Assn.)

Philadelphia St. Louis Salt Lake City Los Angeles Minneapolis Houston
Portland Atlanta Denver Chicago Dallas El Paso Spokane

MULTI ARMCO PLATE

ARMCO MULTI PLATE

★ FOR MODERN ROADS ★



● *Fairmont E5(M27) burns on both sides at once. Limits of burning 4' to 25' from track center*

EFFECTIVE WEED CONTROL *by Burning*

Weed control, to be effective and most economical, must both *kill and consume* all vegetation on the right of way. Otherwise, dry vegetation left on the track section becomes a three-way menace . . . a hazard of fire, a hindrance to efficient track drainage in wet weather, and an ideal foundation for snowdrifts.

With a background of more than eight years' practical experience, Fairmont now offers a variety of models—a *complete* line of weed burners—so that each railroad may select the exact type of equipment best suited to its needs and conditions . . . burners for track section only, for swathes five and six feet beyond the ties, and burners with wider range for eliminating weeds in ditches or on slopes of banks and fills.

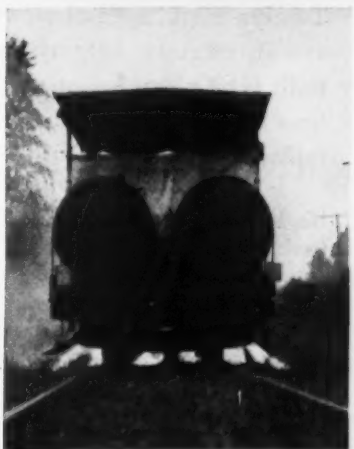
As every Fairmont Weed Burner is an economical machine to operate, *frequent* burning trips may be made at times when weeds can be burned most effectively, thus delivering *complete* weed eradication at the *lowest overall cost.*

FAIRMONT RAILWAY MOTORS, INC., FAIRMONT, MINN.

Inspection Motor Cars . . Section Motor Cars . . B & B and Extra Gang Cars . . Gas-Electric Ditchers . . Shapers . . Ballast Cleaners . . Ballast Drainage Cars . . Mowers . . Weed Burners . . Extinguisher Cars . . Power Cars: Air, Electric, Paint Spray, Tie Tamping . . Rail Coaches . . Motor Car Engines . . Push Cars and Trailers . . Roller Axle Bearings . . Wheels and Axles.

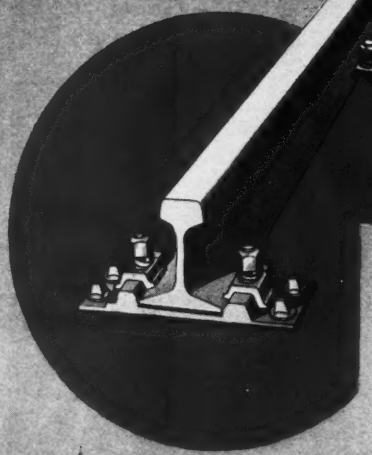
Performance ON THE JOB COUNTS

Fairmont



● This Fairmont D(M27) Oven-type Weed Burner has proved its efficiency and exceptional low mile-cost. A track-oven 8 ft. long and 9 ft. wide holds all heat down within 13 in. of the rail top. The D(M27) requires only a 2-man crew when the operator or helper is pilot.

An AMERICAN JURY gives its VERDICT



Twelve men . . . all of whom are intimately acquainted with GEO Track Construction . . . have expressed the following opinions:

• • •

No. 1—"The line and surface of this track is practically perfect."

• • •

No. 2—"It is my belief that we will find that the maintenance on the GEO is less than half that on standard track."

• • •

No. 3—"GEO is the best piece of track we have."

No. 4—"This piece of track is the smoothest riding track we have on this division."

• • •

No. 5—"We feel justified in stating that GEO Construction should materially increase the life of rail, particularly on curve track."

• • •

No. 6—"Our maintenance costs for labor have been materially less on GEO track than on standard track."

• • •

No. 7—"It virtually eliminates the possibility of rails spreading and permits replacing of worn rails without damage to ties. It reduces noise to a minimum."

• • •

No. 8—"It is noiseless and those riding trains can tell immediately when they get on and leave this track."

• • •

No. 9—"The track is not churning, rides smoothly, and is much more noiseless than the adjoining track."

No. 10—"While GEO is costlier in the beginning, we believe that in the end it will result in a great deal of economy because the maintenance work on this type of track has been very much less than on standard track adjacent thereto."

• • •

No. 11—"The lateral movement of the rail is quite materially reduced with the GEO type construction."

• • •

No. 12—"The thought has come to mind that if the many things in track which down through years of experience we have been trying to overcome, such as mechanical wear of ties, creeping of rail, holding expansion, maintaining good gauge, preventing the battering of rail ends, maintaining good line, etc., could come under one sustained direction for analysis, and a design of appliance be developed to meet all the requirements as nearly as possible, the probability is that a design such as the GEO would be the result."

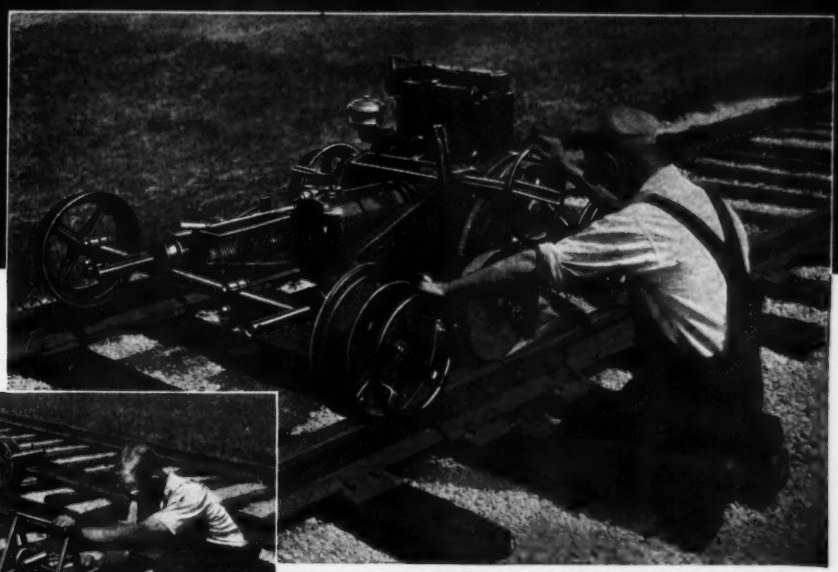
CARNEGIE STEEL COMPANY • PITTSBURGH • PA

United States Steel Corporation Subsidiaries

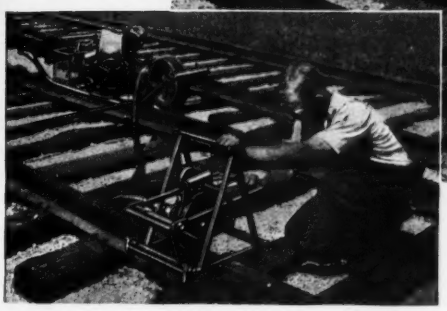
THE LORAIN STEEL COMPANY • JOHNSTOWN • PA

Better and Faster Rail Grinding

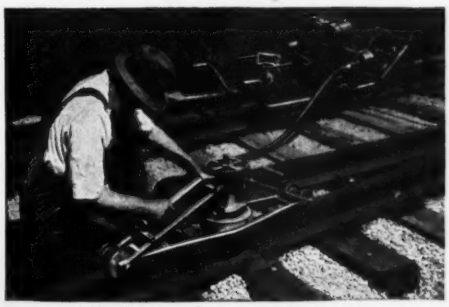
These two Nordberg Rail Grinders



Surface Grinder for welded rail ends. Can also be arranged for beveling.



Utility Grinder with guide for slotting and beveling.



Attachment for super-accurate surfacing.

Removing flow from switch points and stock rails.

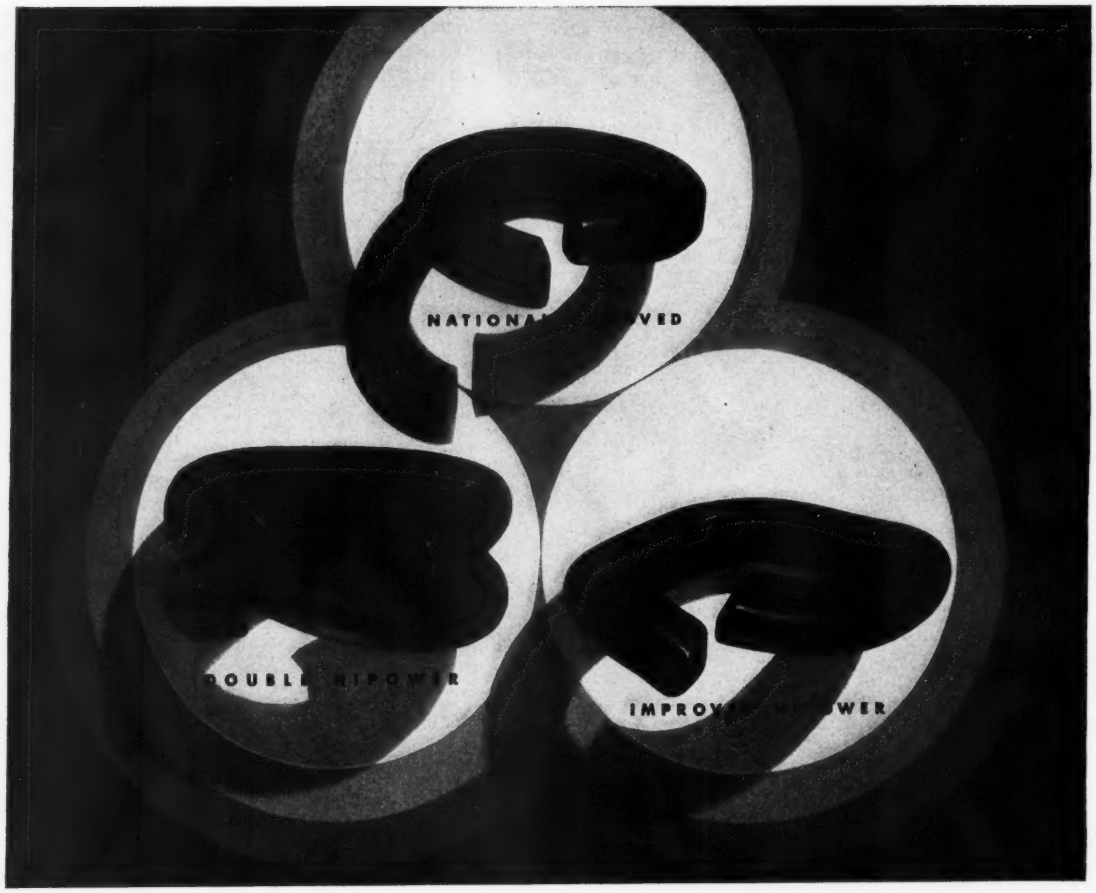
These two grinders with their appliances meet the needs of today's problems in rail re-conditioning. For smoothing up welded rail ends, cross cutting, grinding at switches, frogs, etc., they do the job better and in less time, thereby materially reducing the expense of this work.

In addition to these two grinders, Nordberg also builds the six other machines listed below. For better maintained track, standardize on Nordberg Equipment.

ADZING MACHINE	TRACK WRENCH
RAIL DRILL	SPIKE PULLER
POWER JACK	TRACK SHIFTER

NORDBERG MFG. CO.

MILWAUKEE, WIS.



HIPOWERS

We make spring washers for every track use

—for track joints, tie plates, angle bars.

—for frogs, and crossings.

—for anchor screw spikes, and clip bolts.

Millions of our spring washers are saving money for the railroads today. Probably we can save more for you.

BEFORE ORDERING CONSULT OUR ENGINEERING AND SALES DEPARTMENTS

THE NATIONAL LOCK WASHER COMPANY

NEWARK, NEW JERSEY, U. S. A.

AIRCOWELDING

now even more economical with the new AIRCO

TWO-FLAME TIP

This modern cost-saving Airco method of building up and heat-treating rail ends, now takes another big forward step, in Airco's development of the TWO-FLAME TIP. It achieves greater heat, faster heat, more intensive heating of the area required, and consequently less heat absorption by metal where heat is not required. It saves gas, saves time —and saves rails.

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WELDING and CUTTING APPARATUS and SUPPLIES . . WILSON ARC WELDING MACHINES

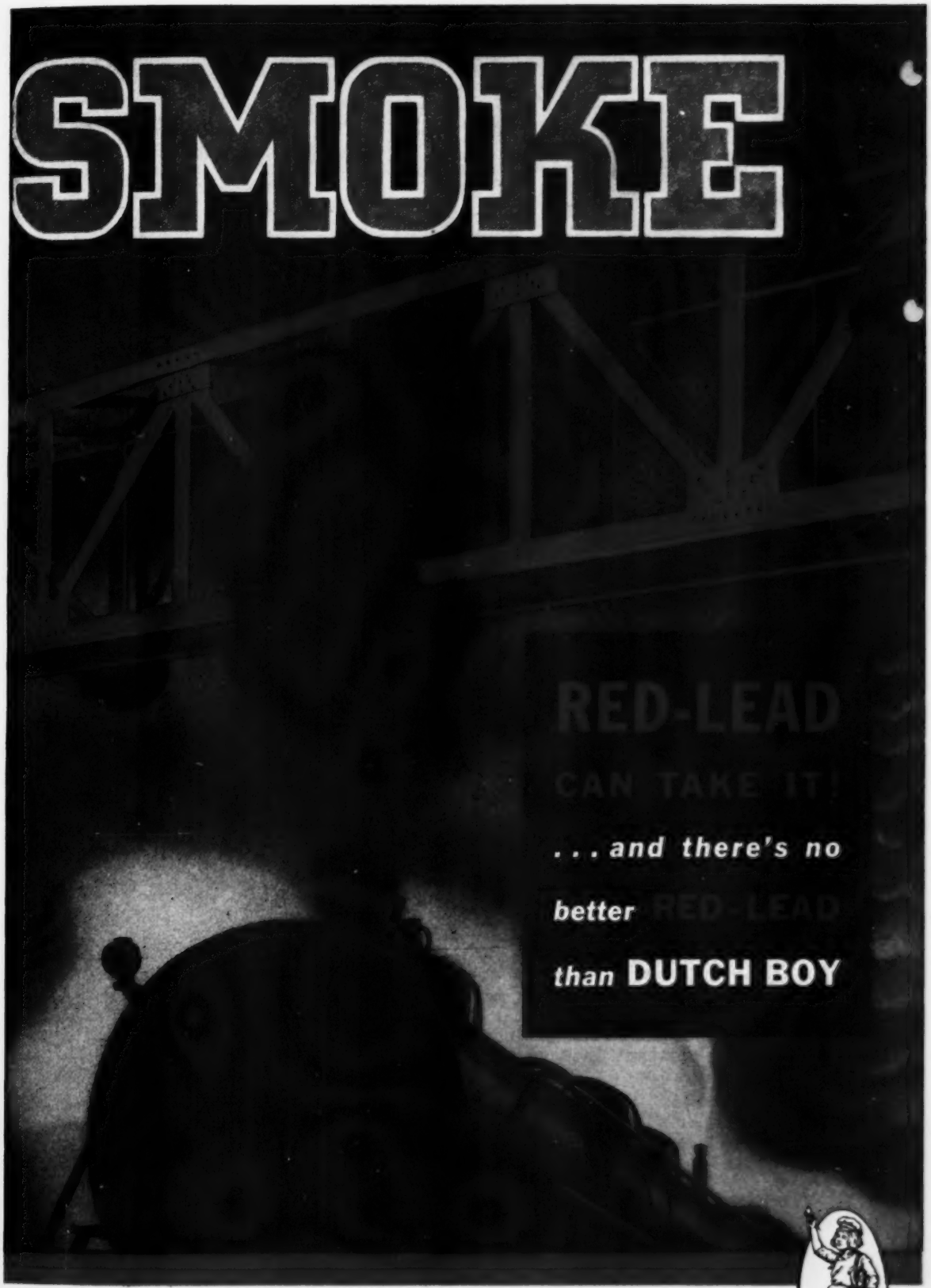
Maintenance work is varied work. It requires equipment of many types—all with the one objective of effecting economy.

This will be the theme of the March issue. It will focus the attention of railway maintenance officers on the place of work equipment in their season's programs—at the time when they are preparing their programs. This issue affords manufacturers of work equipment an unusual opportunity to present their story—when their customers are equipment-minded

Maintenance Mike Says: "Some roads still regard a 'strong back' as the first essential for a maintenance man. I'm for the road with machinery"

17th Annual EQUIPMENT ECONOMICS NUMBER Railway Engineering and Maintenance

RAILWAY ENGINEERING AND MAINTENANCE IS READ BY MAINTENANCE OFFICERS OF ALL RANKS



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No. 74 of a series

Railway
Engineering and Maintenance

SIMMONS-BOARDMAN PUBLISHING COMPANY

105 WEST ADAMS ST.
CHICAGO, ILL.

Subject: You Like It

Dear Reader: January 31, 1935.

We have been gratified to receive so many written and verbal comments from you regarding the changes in typography that we made, beginning with the January issue. We have been pleased because they show the care with which you are reading Railway Engineering and Maintenance. We have been pleased also that the comments have been so uniformly complimentary, for they have confirmed our hope that you would find that the changes which we have made contribute to the ease and pleasure with which you read the publication.

This reaction was expressed by the chief engineer of one of our busiest railways, who wrote us as follows:

> "I extend my compliments on the new makeup of Railway Engineering and Maintenance. The typography and the three column page are more pleasing and afford more eye ease, thereby enhancing the pleasure of reading. The clarity of the cuts is especially noteworthy."

In a similar vein, another system engineering officer of an eastern railway, who is an especially keen student, wrote us as follows:

> "I like the three column style and your new head and subhead type. I enjoyed your admonition to change with the times. It is a timely warning. Most of us can now eat in a cloud of cheap cigarette smoke, but some of our friends still find it difficult to jump through their hands. I applaud your new departure."

These are typical of comments that we have received from numerous sources. They indicate that we are making Railway Engineering and Maintenance more readable and thereby more attractive for you. This is our constant endeavor. We solicit further suggestions from you to this end.

Yours sincerely,

Elmer T. Howson

ETH:JC Editor.

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Statistics SHOW

● The oxy-acetylene process contributes greatly to many of the operating economies which all railroads are striving to accomplish, including—

RECLAMATION of worn materials and parts • REPAIRING at reduced cost • DEMOLITION of obsolete equipment • RAIL END WELDING to prolong the life of rails, to cut maintenance cost and to improve riding quality • HEAT-TREATING RAIL ENDS to postpone batter • FABRICATION of new parts by oxy-acetylene machine cutting.

● The Oxweld Railroad Service Company shows you how to accomplish these applications economically. Are you taking full advantage of this up-to-date welding and cutting service?

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YOUR TIE PLATES CAN'T MOVE—USE ILLINOIS SCREW SPIKES

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208 SOUTH LA SALLE STREET, CHICAGO, ILLINOIS

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Railway Engineering and Maintenance

NAME REGISTERED U. S. PATENT OFFICE

February, 1935

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GEORGE E. BOYD
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Associate Editor

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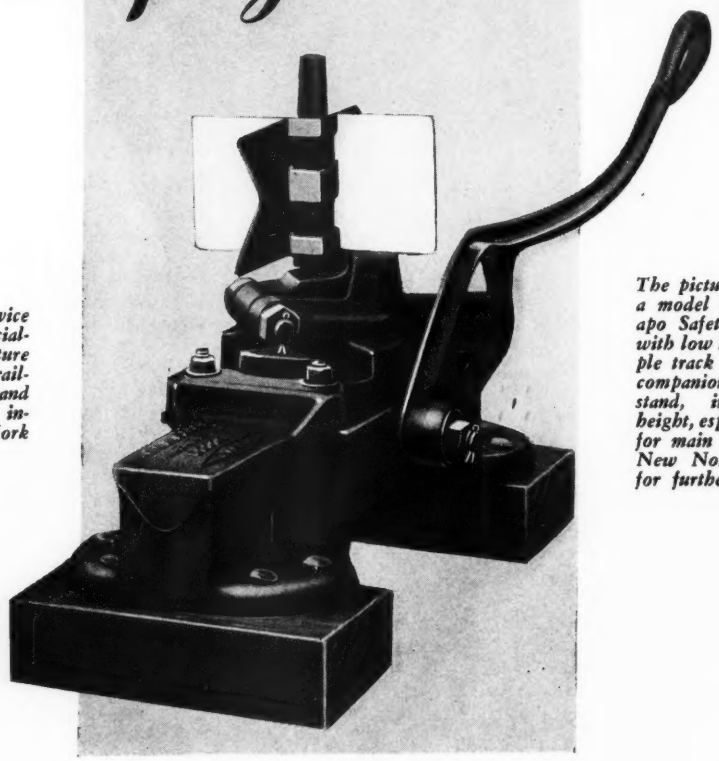
RAMAPO SAFETY SWITCH STANDS

speed up Yard Traffic



Behind Racor Service stand nine plants specializing in the manufacture and distribution of railroad track turnout and crossing equipment, including Manganese Work for heavy traffic.

The picture at the left is a model No. 20-B Ramapo Safety Switch Stand with low target for multiple track locations. The companion safety switch stand, in intermediate height, especially designed for main line use, is the New No. 17-B. Write for further information.

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RAILROAD SPECIAL TRACK EQUIPMENT MANUFACTURING

IN THE rapid handling of cars during switching operations there is the ever-present chance of shunting cars through closed switches with resultant damage to switch points and rigid switch stands. Regardless of the known hazards of such miscalculations, and in spite of the discipline with which switching crews are imbued, mishaps of this kind are frequent. Invariably, with rigid switch stands, they result in delay and expense. This constant threat of trouble makes men over-cautious and slows up their work.

Ramapo Safety Switch Stands completely eliminate all the penalties of trailing through closed switches. When this occurs, a spring mechanism allows the points to move over under pressure of the wheel flanges and properly carry the car on its way. No damage is done to the points or to the switch stand. The target follows the points and indicates their true position, whether thrown automatically or by hand.

RACOR TRADE MARK REGISTERED

So successfully have these simple devices done their appointed task that more than 300,000 of them are in use on 300 railroads.

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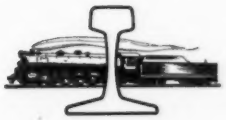
Railway Engineering and Maintenance



RECOVERY

The Part That the Railways Must Play

THE most critical condition confronting the country today is that of unemployment. With more than 10,000,000 persons without work, we face an extremely serious problem. Until it is solved, we cannot have recovery. With its solution, other problems of recovery will be alleviated or eliminated. In this situation the railways occupy a more important position than is commonly realized, even among the employees themselves; the roads are, in fact, the key log in the present jam of industrial paralysis.

President Roosevelt gave emphasis to the key position of the railroad industry in his address at Salt Lake City on September 17, 1932. "The problem of the railroads," he said, "is the problem of each and every one of us. No single economic activity enters into the life of every individual as much as do these great carriers.—Its owners—are the people throughout the country who have a savings bank account or an insurance policy or, in some measure, an ordinary checking account.—Next, the people who work in the railway systems, either directly on the lines or in the industries that furnish railway supplies.—Most numerous of all are the people who ride or ship goods over the steel highways.—The railroad mesh is the warp on which our economic load is largely fashioned. —It is our service of supply."

Durable Goods

Analysis of the sources of unemployment shows that about 1,300,000 of those now out of work come from the consumer industries—foods, clothing, etc.; more than 4,500,000 come from the service industries—transportation, etc., and a like number from the durable goods industries. Since the service industries derive a large part of their business from the durable goods industries, any improvement in the latter will also aid the service industries and strike at the source of nearly 90 per cent of the unemployment. As employment increases, there will also come a larger demand for consumer goods, completing the cycle. The focal point for relief is, therefore, the durable goods industry.

A survey of the durable goods industry shows at once that the railways are its largest buyers. In normal years, they take more than 21 per cent of the steel produced, their lumber requirements exceed 15 per cent of the cut of the country, they consume 24 per cent of the coal, etc. Furthermore, their purchases are highly diversified; they normally buy more than 70,000 different items. A single project along the Atlantic seaboard recently provided more than 50,000,000 man-hours of employment in factories, mines and forests in 38 different states, while an analysis of the 1934 purchases of 26 railroads operating less than 40 per cent of the mileage of the country showed orders totaling $500 or more going to 7,816 different companies in 1,611 individual communities located in every state.

Railway Purchases Reduced

In 1929, the purchases made by the railways from manufacturers totaled $1,442,434,000. In 1932 and 1933 they averaged only $320,250,000 per year. In the last five years, the *reduction* in railway purchases approximated $6,195,000,000. In comparison, the expenditures of the federal government up to July 1, 1934, for *all* emergency purposes, including relief, agricultural credit, loans to banks, public works, etc., totaled $6,452,846,304, and of this latter amount only a small portion went for materials. In other words, the vast sums spent by the federal government for labor *and* materials for all of its various emergency activities up to last July exceeded by only a slight amount the *reduction* in railway purchases of materials alone since the depression began, and this reduction was almost wholly in durable goods.

A decline in buying of this magnitude cannot have other than a paralyzing effect on those industries that normally receive these orders. Furthermore, by reason of the wide distribution of these orders, as already stated, the effect of a curtailment of this buying is equally widespread. No other industry, by reducing its purchases, creates unemployment in so many communities. Conversely, any measure that will promote railway buying becomes of widespread interest.

Much Work Stopped

This drastic decline in purchases has been brought about in part by curtailment in expenditures for maintenance and repairs. It is estimated that the deferred repair of motive power and rolling stock amounts to $500,000,000, while the deficiency in roadway maintenance exceeds $700,000,000. Specifically it will require at least 3,500,000 tons of new rail and 85,000,000 ties, over and above current renewals, to bring the tracks back to the condition which prevailed in 1929. Nor does this comprise

the entire story of retrenchment, for there has been an even greater reduction in capital expenditures. In the eight years from 1923 to 1930, inclusive, the Class I railways spent an average of $842,714,500 annually for additions and improvements to their properties, approximately two-thirds of which went for roadway facilities. During the years 1931-2-3, the *reduction* in expenditures of this character totaled $1,895,544,500.

That this program of improvement was not completed is indicated by the fact that it was pressed for a full year after the collapse of 1929 occurred, capital expenditures in 1930 totaling $872,608,000 a figure exceeded only once and that by less than 2 per cent in the very active year of 1926. It was only as the full extent of the depression became apparent that the necessities of the situation forced the suspension of much of this work.

Furthermore, demands are arising today for services unthought of as recently as five years ago, typical of which are the air conditioning of passenger equipment and the development of trains capable of markedly higher speeds than have heretofore been operated, three of which have already been built, while a dozen others are under construction. With the further strengthening and improvement of the tracks and structures to permit these faster speeds, with centralized dispatching and other signaling facilities to eliminate delays to these trains, and with the modernization or replacement of much present-day equipment, it is self-evident that the need for capital expenditures is as great as ever.

Where Relief Must Come From

The paralysis of the capital goods industry brought about by the drastic reduction in railway buying has not arisen, therefore, from any lack of need. On the contrary, it is due to sheer inability to buy, brought about by a decline in earnings of the most violent character. It is here that relief must be applied if employment is to be increased in the durable goods industry. This relief can be given in several ways.

The first and most direct means would be through an increase in traffic. This can come in any large degree only through a revival in business, for which revival the government has been spending vast sums during the last 18 months, without marked success. We must look, therefore, to other avenues.

While awaiting an upturn in traffic, the railways have undertaken the most direct means available to them to increase their revenues—by initiating increases in certain of their freight rates. The increases applied for are estimated to yield some 170 million dollars annually, an amount insufficient to meet even the increases in costs of materials and in wages imposed by government action, but sufficient, it is hoped, to start some recovery of net income.

Of greater ultimate possibilities are measures which the railways are seeking in the way of legislation designed to bring the railways' competitors on the highways and on the waterways under regulation comparable with that now imposed on the railways. Subsidized and largely unregulated competitors are now taking from the railways a billion dollars worth of traffic a year, much of which would return to the rails with comparable regulation as to stability of rates, dependability of service, protection of employees, etc. With the elimination by states and nation of the present inequalities of competition, there would be restored to the railways a volume of traffic sufficient to contribute greatly to the solution of their financial difficulties and restore their net operating income to a level sufficiently high to encourage them to come back into the durable goods market for the materials they need so badly.

When the Start Must Be Made

From the above it is evident that recovery can be attained only by the setting in motion of a cycle of events which must start with the railways. Given the increases in freight rates for which they have asked and legislative aid in correcting handicaps to which they are now subjected, the net income of the railways will be increased to the point where they can return to the durable goods market for the materials that they need. This will increase employment in those industries where unemployment is now most pronounced. It will also lead to increased traffic on the railways themselves, incident to the movement of raw materials into and finished materials out of the plants of those who make the cars, the locomotives, the rails and the many other kinds of materials and equipment used by the roads. It is with the railways, therefore, that recovery must start. It is for this reason that the legislative program of the railways that is now being advanced is of such direct importance to the welfare of the public as a whole. It is the most important single step that can be taken toward national recovery.

ROOFS

Their Application and Maintenance

PROBABLY no class of work carried out by maintenance forces has been subject to more variations in practice than that of applying and maintaining roofs. While there are some exceptions, in general, roofing practices have been developed by the local forces on each division, with little or no reference to the practices on other divisions of the same road.

This is a matter to which little attention has been given in the past by system engineering officers, partly because roofing is in large measure a proprietary material which, presumably at least, will give best results when applied in accordance with the manufacturers' instructions. In part also, this attitude has its origin in the fact that the condition of a roof can often be determined only through a minutely detailed examination which, obviously, must be made by the local building forces. For these reasons many of the variations in practice that have developed have escaped the notice of system officers and, until recently, few of them have realized how widely divergent some of the practices on their own roads are.

It is because of these conditions that we hope that the articles on roofing practices which are now appearing serially will be of help to those confronted with the problem of building maintenance.

STORMS

The After Effect Is of Greater Concern

A COLD wave sweeping across the continent from Puget Sound to Florida, severe floods in the lower Mississippi valley, a raging blizzard along the Atlantic seaboard, avalanches in the Cascade mountains and the destruction of a railway bridge in Wisconsin following the failure of a dam, all competed simultaneously for front-page space late in January. As news, they were worthy of special note because of their simultaneous occurrence, but taken individually they were no more than incidents that a railway maintenance officer must expect to face at any time within the regular season for them, and not infrequently out of season and when least expected.

In many respects the maintenance officer of today enjoys marked advantages over his predecessors in meeting these emergencies. Both track and bridge forces are provided with better material-handling equipment. Thanks to track motor cars, and other means of transportation, their forces are afforded a higher degree of mobility under all conditions except those imposed by snow and sleet storms. But here the disadvantage is offset by the availability of snow melters that greatly reduce the need for moving large numbers of men.

On the other hand, there is reason for concern regarding the cumulative effect of the trend toward heavier precipitation. The period of the depression with its restricted expenditures for maintenance has also been a period of less than average rainfall, taking the country as a whole, with the result that maintenance has been favored by a subnormal moisture content of the roadbeds. With a return to more normal rainfall especially in the face of deferred programs for reballasting, conditions far less favorable to the maintenance of good line and surface may be expected.

INSPECTION

Do Not Get Into a Careless Habit of Mind

THERE are bridges in service today that are much older than any man now in railway employ. But they are the exceptions; men live longer than most bridges. On at least one railroad, one man occupied the position of general erection foreman long enough to supervise the erection of one set of steel spans three different times as they were relegated in turn to less important lines. The bridge and building supervisor is young indeed who has not redriven more than one trestle in a given location.

In spite of these experiences, the fact remains that the life of railway bridges is steadily increasing; the period of rapidly mounting weights of rolling stock that gave rise to heavy renewals of steel bridges is a thing of the past, while the widespread use of treated timber has greatly prolonged the life of pile trestles. Because of this and because of certain habits of mind, some officers of bridge maintenance are inclined to underestimate the age of the bridges in their charge. True, they can readily determine just how old they are, but offhand they may think of the time of construction as, say, 10 or 12 years ago, when actually it was 16. While this point is of no consequence in the abstract, it does have a rather definite significance in connection with the inspection of bridges, for an old structure should ordinarily receive closer examination for the discovery of concealed defects than one of recent construction.

Care must be taken also to insure that the personal equation does not enter into the inspection from another angle. Some division officers of bridge maintenance fall into a careless habit of mind because they know, or think they know, their bridges so well. The general appearance of a structure may not change much in a year's time, and if it was pronounced thoroughly sound a year earlier, it is easy to allow the result of the previous report to influence judgment that should be founded entirely on the current inspection. In these days of curtailed maintenance programs, it is doubly important that bridge inspections be made thoroughly and conscientiously.

ACCIDENTS

Are We Approaching the Limit of Safety?

HOW are our tracks today? This question is always before track maintenance officers, although, because of the marked improvement in the accident record since 1925, it has had more significance as a matter of personal discipline than as a point of issue. However, in view of the long period of curtailed maintenance appropriations, it is worth while to examine the record.

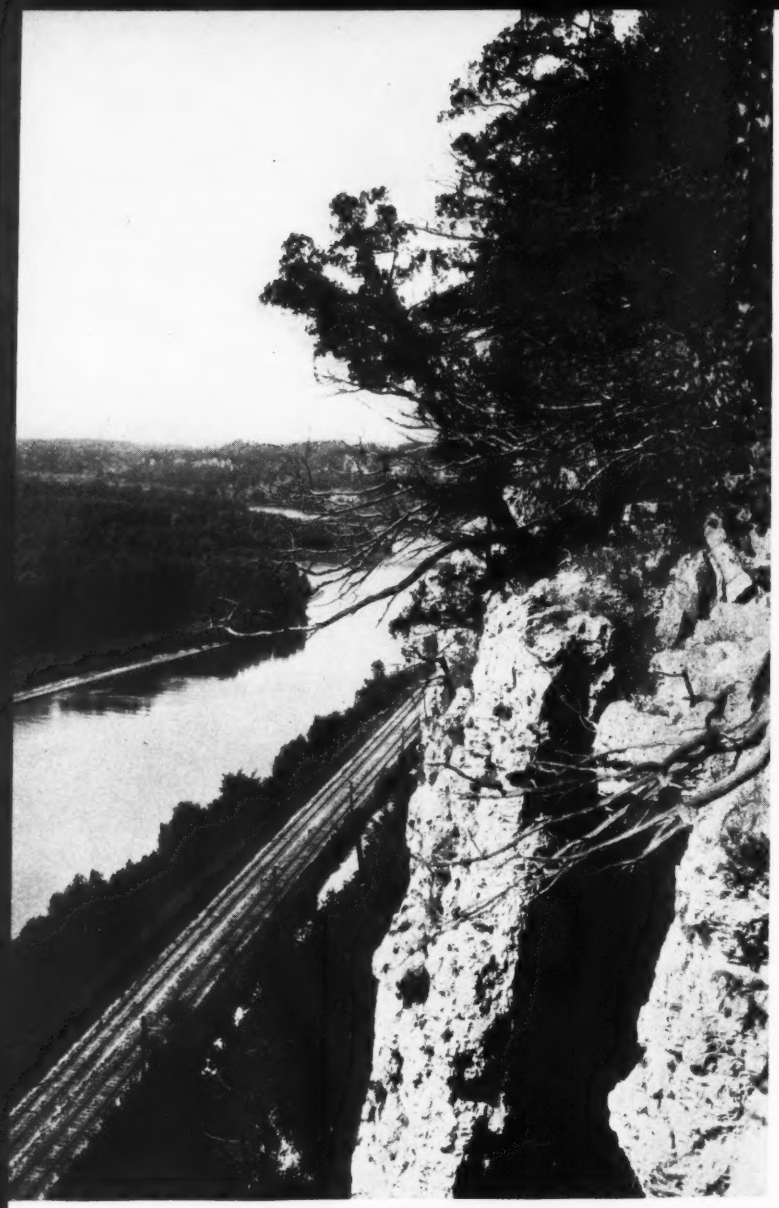
Train accidents necessarily vary with the number of train or locomotive miles run; consequently, any comparison of train accidents must be expressed in terms of equal traffic or, more accurately, equal locomotive mileage. In 1925, there were 1,925 train accidents on Class I railroads per billion locomotive miles ascribed to defects in, or improper maintenance of, tracks or structures. In the following years the number decreased, corresponding figures being 892 in 1930, 698 in 1931, and 603 in 1932. However, in 1933, the figure was 607.

Corresponding figures are not available for 1934, but a somewhat similar comparison can be developed from the trend of derailments from all causes for successive six months' periods up to and including June 30, 1934. Thus, the number of derailments per million locomotive miles in the first half of 1929 was 5,830, while in the following 3½ years the record improved steadily so that the same figure for the second half of 1932 was 2,910. But in the three following half-year periods the number of derailments increased, as indicated by the consecutive figures, 3,010—3,350—3,360, the last being the total for the first half of 1934.

This record is by no means conclusive; the time is probably too short to show the true trend, but the break in the steady decline in the accident record is sufficiently pronounced to warrant real concern. Subordinate maintenance officers have done their part in meeting the demand for ever lower appropriations for maintenance, but they owe it to their managements as well as to themselves to sound a note of warning when the danger point is being approached, for they know more accurately than any one else just what the cold physical facts are.

Saving a M

The Chicago, Burlington & Quincy has used treated ties since 1899 in accordance with a well defined policy that has been modified only as service data and the records of tie test sections have pointed to opportunities for improvement. Throughout this entire time, however, there has been no deviation from the original objective—that of obtaining the maximum return for the money spent. That this objective has been realized is made clear in this record of the Burlington's experience in the preservative treatment of its crossties.



Along the Wisconsin Bluffs on the Burlington's La Crosse Division

THE first treated ties were used on the Burlington in 1899. In that year a treating plant was built at Edgemont, S. D., which in three years treated 1,150,000 ties, about 50 per cent western yellow pine and 50 per cent fir, using ½ lb. of zinc chloride per cubic foot of wood. In 1902 this plant was moved to Sheridan, Wyo., where 19,900,000 ties have since been treated, of which 13,000,000 were western yellow pine, 6,000,000 were fir and the rest miscellaneous species. Approximately 16,500,000 of these ties were treated with ½ lb. of zinc chloride per cubic foot of wood and 3,250,000 by the Card process, namely, with ½ lb. of zinc chloride and 3 lb. of cresote per cubic foot of wood.

In 1908 the treating plant at Galesburg, Ill., was completed, since which time 33,200,000 ties have been treated there to date. These have been largely red oak, but white oak, southern pine and gum ties have also been treated in considerable numbers, as well as smaller quantities of ties of miscellaneous species. About 10,000,000 of these ties have been treated with ½ lb. of zinc chloride and 22,000,000 by the Card process, with ½ lb. of zinc chloride and 2 or 3 lb. of creosote per cubic foot of wood. Of the ties subjected to the Card process, approximately 500,000 have been treated with ½ lb. of zinc chloride and 3 lb. of water-gas tar. About the same number of southern pine ties have been treated with Grade 1 creosote to a net absorption of five pounds per cubic foot of wood.

In addition to the ties treated at these company-owned plants, about 7,400,000 ties have been treated at commercial plants. These ties were treated largely by the Card and Burnettizing processes, approximately one half by each method. A summary of the foregoing shows that since 1899, the Burlington has used about 61,650,000 treated ties.

Treated ties were first used by the Burlington on its lines west of the Missouri river, probably for the reason that while white oak ties were still available for its lines east of the Missouri river, it was becoming difficult to supply them for the entire system, and pine and fir ties were readily available in the western territory. Untreated, these pine and fir ties did not last long enough to justify their use, but treated, they gave very satisfactory service. Treated ties were first used on Burlington lines east of the Missouri river in 1908. During all this time and for a number of years afterward, both treated and untreated ties were used in varying proportions. Since 1921, practically no untreated crossties or switch ties have been used, and the ties in all Burlington tracks are now and have for some time been practically 100 per cent treated.

It will be noted that nearly one-half of all the treated ties used on the Burlington have been subjected to the Burnettizing process. When

*A paper read before the convention of the American Wood-Preservers' Association at New York on January 23.

a Million Crossties a Year*

By H. R. CLARKE

Engineer Maintenance of Way, Chicago, Burlington & Quincy

the practice of using treated ties was begun, there was a definite and immediate increase in annual tie costs, due to the greater cost of the treated ties as compared with the untreated ties formerly used and because there could be no immediate decrease in the number of ties required.

The increased investment was justified by the longer life of the treated tie and the ultimate reduction in annual ties costs, but there was necessarily a limit on the expenditure that could be allowed and the zinc chloride treatment was adopted as it was thought that the greatest benefit would be realized by treating the largest possible number of ties within the expenditure limit authorized. This was effected by the use of the less expensive treatment. Further, although creosote had been used as a wood preservative for many years before the Burlington began treating ties, no definite data were available showing the relative results obtained from the two methods of treating, and the cost of the creosote treatment was materially greater than the zinc chloride process. For these reasons the Burnettizing process was favored.

By 1908, further data were available on the service given by creosoted ties and information was being secured showing the results of the use of zinc chloride-treated ties on the Burlington. The study made at that time brought out facts demonstrating that the additional expenditure for treated ties was justified and that the addition of creosote might be expected to bring about an ultimate saving, especially on that part of the system where rainfall was heaviest. This led to the practice of using zinc chloride-treated ties in the semi-arid territories and Card-process (zinc chloride and creosote) treated ties where the rainfall was heavier, or in a general way, in the use of zinc-chloride ties on the lines west and Card-process ties on lines east of the Missouri river.

There was also a difference in the species of timber used. In the eastern territory it was largely red oak, with some white oak, gum and southern pine, and a small per cent of various species. In the western territory it was largely western yellow pine and fir. Some ties for Eastern lines were obtained locally along Burlington tracks in Illinois, Iowa, Missouri and Wisconsin, but the bulk of the ties came from off-line points in Kentucky, Tennessee, Missouri and Arkansas, and later further south in Alabama and Mississippi. For Western lines, yellow pine was available locally on our tracks and fir was secured from the Pacific Coast.

Crossties Treated on the Burlington—By Processes

Card Process—½ lb. zinc chloride, 2 or 3 lb. creosote	29,100,000
Card Process—½ lb. zinc chloride, 3 lb. water-gas tar	600,000
Burnettizing Process—½ lb. zinc chloride	29,700,000
Straight creosote—5 lb.	625,000
Petroleum Oil and Creosote—50 per cent each by Vol.-8 lb.	1,300,000
Various	325,000
Total	61,650,000

Followed Until 1930

This standard for species of timber, source of supply and methods of treatment was generally followed until 1930, except during the years 1914 to 1917, inclusive, when, because of inability to secure sufficient creosote at reasonable cost, practically all ties were treated with zinc chloride only.

What have been the results? From 1900 to 1918, inclusive, when practically all the old ties being replaced were untreated, the requirements averaged more than 3,000,000 ties a year, ranging from a low of 2,500,-

The Results Have Justified the Burlington's Policies with Respect to the Selection and Treatment of Crossties

000 to a high of 4,000,000. The average renewals per mile per year ranged from 250 to 370 and averaged not far below 300, equivalent to about 10½ years' life. The renewals made indicate that at times, even in those years, factors other than tie conditions were governing. The ties on which this annual average was made were largely untreated white oak and cedar. In 1919, the annual renewals dropped to 2,200,000 and, with slight yearly variations, averaged about 2,200,000 until 1930, which equals about 165 ties per mile per year or 18½ years' life. The ties on which this renewal average was made were largely red oak, southern pine and gum, treated by the Card process, and western yellow pine and fir treated by the Burnettizing process.

This extension of service life from 10½ to 18½ years, or an increase of 8 years, and a decrease of nearly 1,000,000 in the number of ties renewed per year have resulted in a substantial saving. The average life for untreated ties was established largely by the use of white oak and Cedar timber. The supply of these species had become depleted, it was more and more difficult to secure the number of ties needed and the cost was steadily increasing. In a few years the available supply would have been exhausted and the price would have become prohibitive. The average life for treated ties was established by the use of red oak, western yellow pine, fir, gum, southern pine and smaller numbers of other species of timber. An ample supply of such species was and has continued to be available. Untreated, they were not suitable for use, but treated they gave better results than white oak and cedar, which had previously been considered about the only satisfactory timber available.

Influence of Tie Plates

Other factors, in addition to the treatment of ties, must be given some credit for the showing made. Tie plates were used to reduce the mechanical wear. At first they were of inadequate dimensions, but later the size was increased. Better ballast conditions, heavier rail, rail anchors, etc., also contributed. However, as an offset to this stronger track structure, wheel loads, speed and density of traffic increased greatly.

From the figures quoted, it will be seen that the use of treated ties has been an important factor in reducing maintenance of way expenditures on the Burlington. It is difficult, if not impossible, to arrive at any definite figure for this reduction, because the cost of the untreated tie has varied materially from time to time, as have the costs of treatments. Also, it must be remembered that if it had not been for the conservation of timber through treatment and the possibility of using the so-called inferior woods when treated, the supply of timber suitable for use untreated would long ago have been exhausted. Assuming, however, that the supply of timber suitable for use untreated had not been exhausted and that the price had not become prohibitive (neither of which assumptions would have been realized), the comparison would not have been unfavorable to untreated ties. But as we know that timber averaging 10½ years service untreated could not have been secured, the comparison must be made on another basis.

Policy Justified

As stated above, the standard established nearly 25 years ago provided, in general, for the use of pine or fir ties treated with ½ lb. of zinc chloride on the lines west of the Missouri river and oak, pine and gum Card process treated with 1½ lb. of zinc chloride and 3 lb. of creosote on the lines east of the Missouri river. This choice of woods was governed by the species of wood most economically available, all factors considered, while the choice of treatments was based partly on the data available and partly on the cost as compared with other processes and methods. The results justified the decision. However, research was not discontinued. The continual study and comparison of tie renewal statistics on all parts of the system developed the fact that zinc chloride-treated ties were not giving satisfactory service on the lines west of the Missouri river, either when compared with renewal of Card process-treated ties on the lines east of the Missouri river or with the expectancy, based on the original studies. Investigation brought out facts that pointed to two causes for this. The first of these is increased moisture. Rainfall in parts of the territory seemed to have increased and as more land was brought under irrigation, submoisture in the track increased greatly in many places. This accelerated the loss of the zinc chloride by leaching. The second was the effect of the extremely dry, hot territories in the mechanical destruction of the zinc chloride ties (that is, they checked, split, splintered and went to pieces, but did not decay) by the chemical action of the salt in concentrated form, on the cellulose in the wood fiber. As a result, it was decided in 1930 to discontinue the use of zinc chloride alone and to treat all ties by the Card process.

This conclusion, based on a review of general tie renewal statistics and repeated inspections of ties in track, was verified by a study of the data developed over a period of 25 years of observation and the record of special experimental lots of ties. In 1909 and 1910, 20 experimental lots of ties, with 1,000 or more ties in each lot, were put in track in scattered locations over the entire Burlington system, on lines of heavy and of light traffic. A number of different species of timber were placed in each lot. Some ties of each species were untreated and the others were given different kinds of treatment.

These test lots have been followed carefully. An inspection is made each year by the superintendent of timber preservation, accompanied by the district engineer maintenance of way, the division superintendent and the roadmaster on their respective territories. The roadmaster decides what ties shall be renewed. His decision is not questioned. Records are kept and the data compiled by the superintendent of timber preservation, showing the reason for removal, the kind of timber, the treated or untreated ties and if treated, the method of treatment. The executive and general officers are given a summary of the results and the conclusions reached in the annual report made by the superintendent of timber preservation. These tests have now been continued long enough to develop information of definite value.

Life of Untreated Ties

The average life of untreated ties of 20 different species of timber has been found to be 5.6 years, ranging as shown in the table in a following column.

The ties in the test sections were treated with straight creosote, by the Card process or by Burnettizing, using the same species of wood as were put in untreated. The averages established for all kinds of treated timber by the various methods of treating are as follows:

	Actual Average to date		Estimated Final Average	
	Lines East	Lines West	Lines East	Lines West
Straight creosote	20.9	20.0	26.0	25.0
Card process	17.7	17.4	20.0	19.0
Burnettizing	15.3	14.9	15.3	14.9
Untreated	5.4	5.8	5.4	5.8

From the study of the above data as well as the further scrutiny of

(Continued on page 90)

"Sycamore Trestle"—an Example of the Southern Pacific's Present Day Practice in the Use of Treated Wood in Open-Deck Pile Trestles

Sixty Years' Experience With Treated Timber*

By GEORGE W. REAR

Engineer of Bridges, Pacific Lines, Southern Pacific Company

THE Southern Pacific Company is a pioneer in the use of creosoted timber and in the development of suitable methods for the treatment of Douglas fir. Its first creosoting plant was constructed in 1889, although creosoted material had been in use for some years before that date. At the convention of the Association of Railway Superintendents of Bridges and Buildings in New Orleans, La., in 1895, D. K. Colburn, bridge engineer of the Southern Pacific, lines east of El Paso, Tex., stated that he had installed the first creosoted timber in that section in a ballast deck structure about 20 years previously and that it was still in service. "The object in going to this construction was," he said, "to provide a continuous track and prevent the 'jump' at the end of each little opening. There are no bridges in this section of swamp country on which the approaches can be kept up without continuous work." About 35 per cent of the structures between New Orleans and El Paso were then of creosoted timber.

The discussion at this convention in 1895 shows the attitude of the Southern Pacific 40 years ago. This early recognition of the advantages of the ballasted deck type of trestle indicated the foresight of the men responsible for the structures so long ago. Time has verified the truth of their prophecy as to maintenance. Records indicate that by 1895, the Southern Pacific Lines had built more than 50,000 lin. ft. of such trestles; many of them are still in service and are in such good condition that they will last for many more years. Of course, the trestles built in the early Nineties were too light for present main line traffic and many have been rebuilt for this reason, but where this has been necessary, the structures were generally found to be in good physical condition when dismantled.

Careful Handling

The engineering officers of the Southern Pacific were quick to recognize the necessity for the careful handling of creosoted material and stringent rules were issued covering proper practice. As the years went by, breaches of the rules by workmen became evident in the hollowed-out ends of timbers that had been cut after treatment. Yet while it is certain that many sticks were sized after treatment, there has been much less evidence of decay due to that practice.

In the early Nineties, standard plans were prepared for creosoted culvert boxes in various sizes, and with only a few small changes these standards are still in effect. Several thousand such boxes are in service, many being among those first placed, and few of them have been removed on account of decay. Such boxes are considered to be among the permanent types of culverts and are very economical.

At about this same time, standard plans were developed for creosoted culverts of circular shape, consisting of staves of proper cross-section, bound into form by outside iron hoops. Many of these culverts, up to four feet inside diameter, were placed in service, none of which has been replaced by reason of decay. However, this type of culvert was not so successful, as it had a tendency to flatten down and bulge out. While most of them have remained in service in this distorted condition

*A paper read before the convention of the American Wood Preservers' Association at New York on January 23.

without actually collapsing, many have had to be renewed to prevent failure.

Until about 1889, wharf structures in sea water were constructed with untreated piles of Douglas fir, Redwood and other timbers, some having strong claims of resistance to marine borers. The piles were driven with the bark on and with various coverings and coatings, but with only partial success. With the use of creosoted piling, troubles with marine borers became of small moment, although it took considerable time to learn the care necessary to prevent injury to the timber and to demonstrate how small a puncture would permit borers to enter. It also took many years and much supervision to develop the co-operation of employees in getting creosoted material into structures without injury.

That the first treatment in Southern Pacific treating plants was successful is shown by the fact that when the piles driven in Oakland Long Wharf in 1890 were removed in 1919, after 29 years' service, most of them were fit for redriving in salt water. It was conspicuous in this wharf that the piles that were driven vertically were in better condition than brace piles driven with considerable batter, the difference being due to the fact that the poorer piles were chosen for brace piles and in driving with a batter they were shattered to a greater extent. The water at the location of this wharf is so badly infested with borers that untreated piles are destroyed in about two years. Most of the 14,000 piles removed from this wharf were redriven for land structures and will give long additional service in their new locations.

Other Uses

As the advantages of creosoted timber structures had been proved so early in the Southern Pacific Company's experience, it is only natural that they would be used for many purposes. An effort will be made to outline a number of these uses, with such notes as occur to the writer as the list develops.

(1) Piling for all types of structures—This is probably the best use to which creosoted material can be put. The writer favors a full cell treatment, for both land and marine use. In railroad structures, when the foundation is sound, other repair work is simple. Piles should be handled carefully to avoid breaking the shell of treated material. When cut off to cap level, the top should be given repeated applications of hot creosote oil, followed by a coat of hot asphalt or sealing compound.

It is Southern Pacific practice to place wire bindings around creosoted piles that are to be given reasonably hard driving, these wrappings consisting of six or eight turns of No. 8 or 9 wire, spaced at about three feet intervals from the head down. The wire is placed by fastening an end to the pile with a fence staple and then turning the pile with cant hooks while the wire is held tight, until a sufficient number of turns are made, when the wire is fastened with several staples. These wire bands prevent the shattering of the pile and are used in addition to the regular protection of the pile head, which, of course, depends on the type of hammer used.

Beginning with the construction of a cresoted-timber ballast-deck trestle 60 years ago the Southern Pacific has been a consistent user of treated timber in bridges and culverts as well as in docks where piles are subjected to the ravages of marine borers. This long experience has taught many lessons, which have been crystallized in established rules of good practice in treatment, installation and maintenance that make for a maximum return on the investment in such measures.

It is regular practice on the Southern Pacific to drive creosoted piles as foundation piles under bridge piers, abutments and buildings, where the cutoff is above the moisture line. Investigation of such piles after 30 years' service fails to show any deterioration.

(2) Trestle caps—Experience indicates that caps are more subject to failure than any other part of a well-designed trestle, and that failure generally results from splitting, due to season checks. For trestles on heavy traffic lines, it is good practice to purchase caps of side-cut material, eliminating boxed hearts. Such material costs more, but the additional cost is believed to be justified. It is our regular practice to fasten caps to piles with drift bolts, as this prevents movement between cap and piles.

(3) Trestle stringers—It is Southern Pacific practice to use Douglas fir stringers exclusively on its Pacific Lines, and to a considerable extent on its lines east of El Paso. The standard size is 8 in. by 17 in. by 30 ft. in length. In designing new structures, stresses are limited to 1,200 lb. per square inch, although heavier traffic is permitted on existing structures until stresses reach about 1,650 lb.; under this practice no failure of stringers has been experienced.

We have not found it necessary to allow the ends of stringers to extend across the caps, although there is some wear between the cap and the stringers on open deck trestles on high speed lines. This wear, however, is not nearly so great as between the stringers and the ties, where ties have been found to cut into the stringers as much as ⅜ in. after 23 years' service. This cutting or wear is quite general on trestles that have been in service a long time, depending, of course, on the amount and speed of the traffic.

Close Packing

With untreated timber, the practice has been to place spools between the stringers to separate them sufficiently to prevent decay. Creosoted stringers may be packed tight, although when so packed it is necessary to dress the stringers to an even thickness to obtain a good job. Dressing the stringers to thickness reduces the size one-half inch, or about six per cent. It is Southern Pacific practice to fasten the stringers to the caps with machine bolts in open deck trestles and with drift bolts in ballasted decks.

On the early ballasted deck trestles, a solid deck of 12-in. by 12-in. stringers was placed, but this was not entirely satisfactory as there was more or less movement of the stringers under traffic and the finer ballast worked in between the stringers, spreading them apart. This led to the use of a covering of 3-in. planks, laid crosswise of the stringers, which gave a more even distribution of the load on the stringers and corrected the trouble. Following this, and to obtain a stiffer deck, deeper and narrower stringers were used with the same plank covering.

Standard practice for main lines now provides for six piles per bent, 14-in. by 14-in. caps, twelve 8-in. by 17-in. stringers fastened to the caps at the ends only by ¾-in. drift bolts, 3-in. deck planks fastened with ¼-in. by 6-in. boat spikes and 4-in. by 12-in. guard timbers, the

decks being 16 ft. wide out-to-out. This is somewhat wider than is usual with other railroads, but a considerable proportion of the Southern Pacific trestles have handrails and the 16 ft. width is necessary.

The only defect found in this type of deck is the shrinkage of the deck planks in the arid parts of the country, permitting ballast to drop through. This has led to the general use of battens over the cracks, these battens being made of strips of galvanized iron or 1-in. by 4-in. boards.

Southern Pacific branch line trestles of both the ballasted deck and open-deck types are of lighter design, but of the same general character as those on main lines. The writer has dwelt on trestles to a considerable extent, because there are about 160 miles of trestle-type structures on our lines west of El Paso.

(4) Culverts—No changes have been found desirable in the design of our standard box culverts since they were first used in the Nineties, and it is regular practice to apply creosoted wood in boxes 1 ft. by 2 ft., 2 ft. by 3 ft. and 3 ft. by 4 ft. in dimension. In special cases, larger wooden boxes have been built, some as large as 12 ft. by 12 ft. On new lines it is considered good practice to install wooden boxes of larger size than actually required, with the intention of inserting more permanent culverts of smaller size at a later date. If the wooden boxes are preframed and creosoted, they will be almost as permanent as those of any other type. Liability of fire is the only objection to them. Wooden stave pipe culverts are no longer installed on our lines.

Truss Spans

(5) Truss bridges—The Southern Pacific has installed a number of creosoted truss railroad bridges of moderate length and is securing long life from them, but for present-day traffic a timber truss is objectionable on other grounds than decay and it is probable that we will build no additional creosoted trusses for railroad purposes. Such bridges are very satisfactory for carrying highways over tracks and many are in use. The present practice of providing an asphaltic wearing surface on the floors of highway bridges has added greatly to their economy with the increase in traffic.

While creosoted trusses are not likely to be built on branch lines in the future, due to the availability of lighter steel spans removed from main lines, creosoted pile and timber piers to support these steel girders and trusses are economical in first cost and in maintenance. In a number of instances, the Southern Pacific has placed concrete tops, from 2 ft. to 3 ft. thick, on the creosoted piles to provide greater fire protection.

Too much cannot be said of the necessity for pre-framing timber before treating and the avoidance of cutting timber after treatment. The writer, however, has had little difficulty with bolt holes bored in creosoted timber where the bolts have been placed and remained in place. These holes, many of which were bored 40 years ago, were not treated after boring and in general were slightly larger than the bolts, but very few instances have been found where decay has taken place. Holes that are bored and not plugged or bolted do cause decay.

Many ties on steel bridges have been dapped after creosoting, but none has been found decayed in the dapped portion even after a service of 24 to 28 years. This may be due to the generally dry climatic condition on our lines, but a number of the structures observed are in rather wet parts of the Coast territory.

Discussion

In discussing this paper, R. S. Belcher, manager treating plants, A. T. & S.F., emphasized the value of stringers and caps of side-cut material, stating that while they cost more, they were worth more. F. R. Layng, chief engineer, B. & L.E., stated that he has found by experience that it is entirely practical to frame timbers for bridge decks before treatment, for last year he placed decks on five structures which ranged up to 200 ft. in length without boring a single hole. C. M. Burpee, research engineer, D. & H., emphasized the necessity for securing accurate measurements from the field where timber is to be preframed. He stated also that his road had tried a pre-dapped bridge guard rail but encountered so many difficulties that it now uses a non-dapped guard rail, even though the fastenings do not give a life equal to that of the timber. To overcome difficulty with errors in framing, M. F. Jaeger, manager of the Port Reading creosoting plant of the Reading-C.R.R. of N.J., stated that these roads employ a system of double and triple checking. J. V. Neubert, engineer maintenance of way of the New York Central Lines, deprecated the fear of fires in structures of treated timber, contending that such timber, if properly handled, is less of a fire hazard than untreated timber. He stated that the New York Central now uses treated timber in quantities in the construction of enginehouses. He also maintained that we have much more information regarding the life secured from treated timber than is commonly realized and referred to numerous refinements in the design of structures that have come from this experience. He anticipates more general use of creosoted ballast deck on steel bridges as well as those of timber.

Derailment on Defective Curve

IRREGULARITIES in the alinement and surface of a curve were believed by the Bureau of Safety of the Interstate Commerce Commission to be among the contributing factors in the derailment of a passenger train on the Illinois Central near Centreville, Miss., on September 3, 1934, which resulted in the death of the engineman and the injury of 11 persons.

The derailment occurred on a 2-deg. curve in single-track territory. At this point the track is laid with 90-lb. rail, with 20 treated ties and 8 rail anchors to the panel. It is fully tie-plated and single-spiked and is ballasted with bank-run gravel to a depth of 22 in.

The conclusions of the report of the Bureau of Safety on this accident contained the following statements:

Examination of the track showed that there were many ties with loose spikes, and, in addition, the alinement of the curve was irregular and the elevation was uneven. The elevation varied from 2 1/16 in. to 3⅛ in., with an average of about 2¾ in., and the widest variation in elevation was just north of the point of derailment where there was a variation of 9/16 in. in half a rail length

. . . . . .

This curve was supposed to have been a 2-deg. curve but was not uniformly maintained and, as a matter of fact, there were two points where the curvature was 3 deg. or more. Notwithstanding these irregularities, the speed limit for passenger trains had been increased in the past month from 55 to 65 miles per hour without any change being made in elevation and apparently without any improvement in the maintenance. In this connection it is to be noted that the recommended practice of the American Railway Engineering Association for a speed of 65 miles per hour on a 2-deg. curve would call for an elevation of 5½ in. and on a 3-deg. curve the elevation would be 8⅜ in.; the practice on the Illinois Central system **** would call for corresponding elevations of 4¼ in. and 7⅛ in.

Roofs

Asbestos Shingles—How to Apply Them

IN THE previous article the purpose and scope of the new manual of roofing practices, which has been prepared by the Northern Pacific for the guidance of its building forces, were described. The present article covers the general requirements for asbestos shingles and outlines in detail the methods to be followed in applying those of hexagonal design directly to the roof sheathing. It also includes, as succeeding articles will, the illustrations which form an integral part of the instructions in the manual. The general discussion of methods and the requirements for materials follow:

This is the second article of a series describing the methods which have been adopted by the Northern Pacific for the purpose of unifying the roofing practices on its system. In the present article rules are given for applying hexagonal asbestos shingles directly to the roof deck.

General Requirements

Asbestos shingles shall not be applied to roofs having a slope of less than four inches to the foot.

Before applying the shingles, the roof surfaces shall be swept clean. All loose boards shall be nailed securely in place, and all knot holes, other openings or cracks ¼ in. or more in width shall be covered smoothly with sheet metal nailed securely in place along one side only. All nails or other projections that might pierce the shingles shall be removed.

Shingles shall not be applied when rain is falling or during weather cold enough to prevent the work being done in the proper manner.

All material shall be housed or otherwise protected from the elements or other sources of damage. Shingles shall be stacked on end on plank that is off the ground.

Asbestos shingles may be cut by scoring with a sharp pointed awl and then broken along the score by pressing over a square-edged surface, as shown in the illustration. Holes may be punched with a sharpened nail set or bored with a hand drill.

Materials

Shingles and trimmings shall be rigid asbestos of an approved brand and natural gray in color. They shall be either 16 in. by 16 in. hexagonal in shape or 17 in. by 17 in. of the Dutch-lap type, not less than 3/16 in. thick at the butt, and shall be accompanied by the necessary number of copper storm anchors for applying.

Asphalt-saturated felt shall weigh not less than 15 lb. per 108 sq. ft. Nails for applying the shingles directly to roof decks shall be galvanized, barbed, 12 gage, 1½ in. long, and with heads not less than ¼ in. in diameter.

Nails for applying asbestos shingles over wood shingles shall be galvanized, barbed, 12 gage, 2 in. long, and having heads not less than ¼ in. in diameter.

Nails for fastening saturated felt and sheet metal shall be galvanized, barbed, 12 gage, 1 in. long, and with heads not less than ¼ in. in diameter.

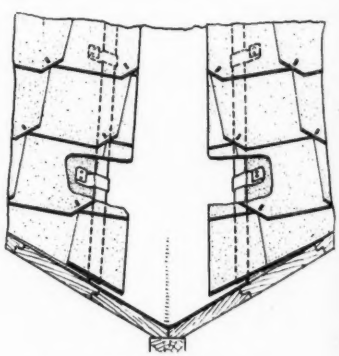
Discs or caps shall be not less than 1¼ in. in diameter and shall be flat. Bell or cup-shaped caps shall not be used.

Flashing, valleys and other sheet metal, except that for covering holes in the roof deck and for gable strips, shall be 16-oz. soft copper of roofing temper. Sheet metal for covering holes in the roof deck and for gable strips shall consist of 24-gage galvanized iron of an approved brand.

Plastic roofing cement shall consist of asphalt containing asbestos fibre and shall be of the proper consistency to be worked with a putty knife or trowel.

Valleys and Flashings

Apply sheet-metal valleys so as to provide an opening not less than four inches wide. To determine the proper width, start with a top width of 4 in. and increase the width of the valley opening 1 in. for every 8 ft. of the length of the valley. Flashing pieces shall be full-length sheets and of sufficient width to cover the open portion of the valley and extend under the roof covering as far as possible without being pierced by the nails holding down the shingles. There shall be no longitudinal seams in open valleys. Cross seams at the ends of sheets shall be locked and soldered. Edges shall be turned back ½ in. and held in place, as illustrated, by cleats spaced not more than 12 in. apart and nailed to the sheathing with two nails.



Open Valley Construction

All intersections of roofs with vertical surfaces of every kind and all openings in roof surfaces shall be flashed with sheet metal. The method to be followed in applying flashing shall be that known as base

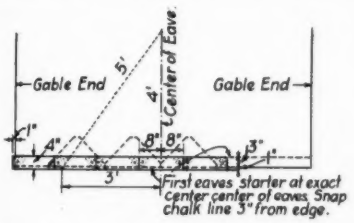
and counter-flashing. Base flashing shall be not less than 4 in. high and shall extend not less than 4 in. out on the roof.

Counter-flashing shall turn down over the base flashing not less than 4 in. When attached to masonry walls, it shall extend back into raked joints not less than 2 in. and shall be securely wedged and cemented in place with plastic cement. Step flashing shall be used where vertical surfaces occur in connection with slopes. It shall be formed of separate pieces set into the masonry, as previously specified, and shall lap about 3 in., but in no case less than 2 in., and shall not be soldered. The various conditions under which flashing is to be applied and the methods for doing so are shown in detail in the illustrations.

Over the entire surface to be covered by the shingles, lay one thickness of 15-lb. asphalt-saturated felt, lapping all seams 4 in., and nail sufficiently to hold in place until the shingles are applied.

Applying Hexagonal Shingles

To present a satisfactory appearance, hexagonal shingles must be lined up both horizontally and vertically, for which reason it is advisable to start the application at the center of the eaves line. Having found the center, snap a chalk line at right angles to the eaves, as shown, to mark the center line of the roof. The line at right angles to the eaves can be obtained easily by using the 3-4-5 method as indicated in the illustration. One should not attempt to obtain this line by measuring along the ridge a distance equal to one-half the length of the eaves and then snap the line between the center points of the ridge and eaves, for experience has shown that roofs



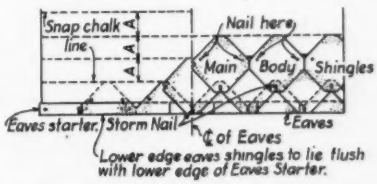
Method of Obtaining a Right Angle to the Eaves

are often out of square. Where this occurs, the center line thus obtained will not be at right angles to the eaves and the shingles will not fit together as they should.

The different shapes of the shingles used in applying hexagonal shingles are eaves starters, eaves shingles, main-body shingles and ridge rolls, all of which are illustrated.

In starting the work, the first eaves starter shall be nailed to the sheathing board under the saturated felt and at the center of the eaves, as illustrated. The remaining eaves starters shall then be laid to the right and left. Eaves starters shall extend one inch beyond the eaves and one inch beyond each gable end, always with the long dimension parallel to the eaves line.

Following this, one eaves shingle shall be laid, as shown, each side of the center line of the roof, breaking joints with the center eaves starter. A copper storm anchor must be set between each two eaves shingles into the slots provided for this purpose in the corners. The eaves shingles are then to be nailed in place with the lower edge flush with the eaves starters,



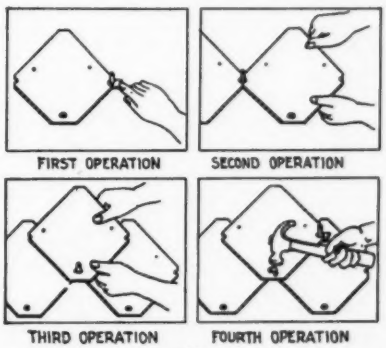
How to Apply Eaves and Main Body Shingles

using two nails to each eaves shingle, through the holes provided for nailing.

It will assist in speeding up the work if horizontal chalk lines are snapped on the roof for each course of main-body shingles, and the head of each course is laid on this line as illustrated. Where 16-in. shingles are being used, allow 8 in. between lines, and allow 5½ in. when laying 12-in. shingles. As an additional guide, several vertical chalk lines should be snapped to the right and left of the center line and parallel to it, running through the center of the eaves shingles.

After the eaves starters and eaves shingles have been laid, the laying of the main-body shingles should be started. To do this, each shingle should be placed so that the hole in the lower corner fits over the storm anchor which has been placed between each two eaves shingles. It is also important to set a storm anchor between each two main-body shingles. These two operations are then continued over the entire roof as indicated in the illustration.

Before nailing the first main-body shingles, in starting each course, it is advisable to set at least three adjacent shingles, in order that they may be lined up properly before any of them is nailed down. In working to the left and right of the center in each course of shingles, always keep one



Sequence to be Followed in Applying Storm Anchors

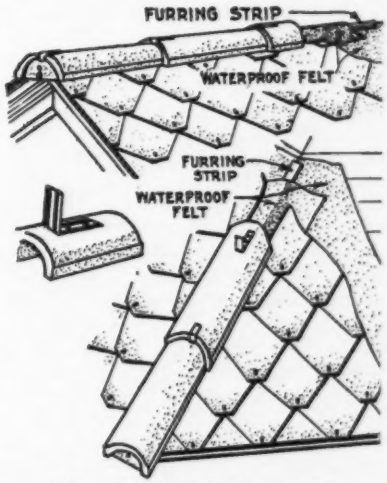
loose shingle ahead of the one being nailed, to insure that the course will be straight, both vertically and horizontally.

Open valleys shall be made to the dimensions already specified, and the shingles shall be trimmed and laid to fit the sides of these openings.

See the illustrations for the method of constructing hips and ridges. In this construction, the main-body shingles on each side of the hip or ridge are to be cut at the furring strip and a piece of saturated felt, the same as is used under the shingles, shall be placed over the furring strip and shall project on each side out under the adjacent shingles.

The furring strip shall be high enough to give proper support to the hip roll, but not to raise it off of the surface of the shingles. The first section of the hip roll shall be set at the lower end and nailed at two points, one near the lower end and the other through a hole that must be drilled at the upper or small end. At this latter point, nail through a copper-ridge, or hip-roll, clip, as shown in the illustration.

The next and all following sections of the hip roll are to be placed as follows: Set them in position against the ridge, or hip-roll, clip, nail them at the upper end



Ridge and Hip-Roll Construction

and then bend the copper clip at the lower end down into the position shown in the drawing. The lower end of the hip may be filled with plastic cement or a piece of shingle cut to fit.

Ridge construction is essentially the same as that used on hips. The furring strip and its covering shall be placed in the same way. The placing of the ridge roll should be started at the end farthest from the direction of the prevailing winds and storms. The succeeding sections should be fastened in the same manner as outlined for hip construction.

When laying hexagonal shingles around a dormer, it is advisable to snap chalk lines to insure that when the shingles have been laid beyond the top of the dormer, they will match as they are worked in from each side. Where both vertical and horizontal lines are employed, the work at this point is made as simple as on a straight roof.

The next article will include those for applying asbestos shingles to the Dutchlap design; the rules for applying both designs over old wood shingles; and the proper provisions for maintenance.

"Coffee Cup" Cut, North of Springfield, Md., Once One of the Wettest Spots on the Baltimore Division, Was Dried Up Completely by Mat-Type Cross Drains

Troublesome water pockets on Maryland and Baltimore divisions of the Pennsylvania were cured by means of unusual cross drains consisting of beds of cinders covered with treated timber mats.

Drying Up Incessantly

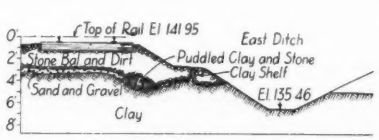
DURING the last three years, the Pennsylvania has been employing with success a method that is unusual in a number of aspects for the curing of wet sections of track in cuts on its Baltimore and Maryland divisions, which for years have stubbornly resisted drainage by deep side ditches. In general, it has been draining water pockets by means of a sloped cross trench at each pocket, in which a 12-in. layer of cinders has been placed 24 in. below the lowest point of the pocket and covered by a treated timber mat, the purpose of which is to preserve the drainage efficiency of the cinders and to so distribute the track loads as to prevent future disturbance of the subgrade, with the possible reestablishment of the pockets. Furthermore, where deep open side ditches would create an unstable condition, it is installing treated wood box drains beneath normal side ditches to collect and carry off the seepage from the cross drains. This method has already been employed at 21 different locations on the two divisions, involving a total of 191 cross trenches and mats, and the installations have, without exception, proved effective thus far, completely stabilizing the track and eliminating the excessive maintenance required before the drainage was installed.

Long Standing Problem

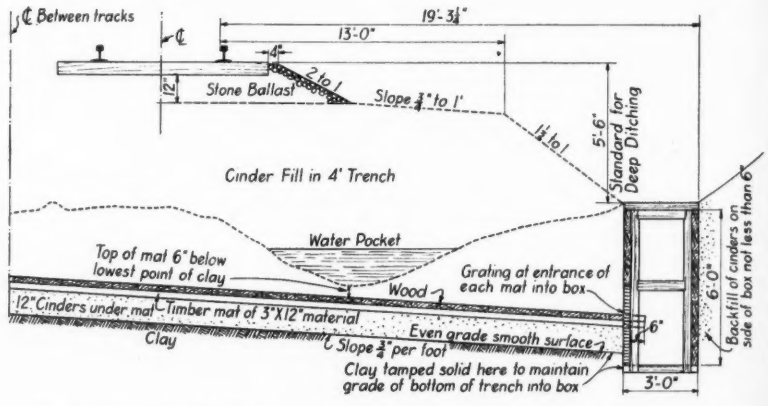
Local sections of unstable roadbed, requiring the frequent application of ballast and repeated surfacing and touching up, are not a recent problem on the multiple-track main line of the Pennsylvania between Philadelphia and Washington, for the ground beneath the tracks through many of the cuts on this line consists of red plastic clay, which, although stable when dry, becomes a slippery, spongy mass when saturated with water, that is readily displaced under pressure. In earlier years, with the train loads and speeds which then prevailed, the problem was not particularly serious and was solved quite successfully by a liberal section of stone ballast to distribute the loads, and a limited amount of additional maintenance to keep the tracks in good surface.

In more recent years, however, with the continual increase in axle loads and the greater speeds of both passenger and freight trains, the cost of maintaining good track increased out of all reasonable proportion. Under the impact of the heavier loads, the tracks at a number of points settled constantly, pushing the plastic clay subsoil up through the shoulders and into the side ditches. The addition of stone ballast to restore the track level proved to be only a temporary remedy, particularly if the clay forced on to the shoulders and into the ditches was removed in an attempt to restore the efficiency of the ditch drainage and improve the appearance of the roadway.

In conjunction with a general drainage, ditching and cut-widening program in this territory during 1929 and 1930, exceptionally deep ditching



Section Through a Water Pocket on the Baltimore Division, Which Is Typical of Conditions Found Quite Generally



Typical Cross Section Showing Details of Timber Mat and Ditch Manhole Box

Three Timber-Mat Cross Drains Extending to an Open Ditch at Jackson Grove, Md. Note Box Drains on Top of Two of the Mats

Wet Tracks

was done at a number of the points giving the most trouble, with the hope of lowering the water level beneath the tracks materially. This afforded relief in most instances, but an investigation of a number of the soft sections of track which persisted, made by digging test holes, disclosed the existence of many water pockets, the water in which could not escape through the clay laterally into the side ditches, even though the bottoms of the ditches were well below the bottoms of the pockets. It was observed that the closer that the soft clay came to the surface in the squeezing action, the more stable it became, gradually building itself up into a solid upward-extending tongue or shelf in the shoulder, practically waterproof in its new location away from the churning action of the ballast. This, obviously, had the effect of deepening the water pockets, or, at least, of raising the water level in the pockets. In several places, in spite of the existence of deep side ditches, this hard clay shelf formation actually permitted the water level beneath the tracks to build up to within a foot or two of the ties.

Dug Test Holes

Finding this condition, it became evident that the only way to cure the water-logged sections of track was to determine definitely the locations of all of the water pockets and then to provide positive drainage laterally into permanent side ditches. This is what has been done in the recent work, which is still continuing and is receiving impetus by the fact that still greater speeds will prevail in this territory with the completion of that portion of the road's New York-Washington main line electrification, south of Wilmington, Del., the present terminus of electric operation.

To determine the conditions existing beneath the surface at the different soft spots to be drained, test holes are dug at intervals along the track, usually in the outside ballast shoulder because of the fact that the outside rail has generally showed the greater tendency to settle. These holes, which are spaced at intervals of approximately 10 ft., are dug into the ballast shoulder and are extended inward between ties to a point directly beneath the outside rail.

The holes are all dug by hand with ballast forks and shovels, and, to prevent any disturbance of the track, which is maintained in service without slow orders, they are put down alternately and are made as narrow as possible. In each case, the holes are carried down to sound dry subgrade to establish a true profile of the top surface of the dry clay.

As might be expected, the profiles established in all of the different wet areas explored to date have been very irregular, showing, in most cases, a series of pockets from which water would not drain into the side ditches. The bottoms of the pockets have generally been from four to five feet below the base of the ties, but in a few cases they have extended down as far as seven feet. In almost every case water has been found, and in some cases within a foot of the ties, in spite of the fact that deep side ditches, perfectly dry, existed only a few feet away. This situation gave convincing evidence of the impervious character of the clay beneath the ballast of the tracks, and of the general inability of water accumulating in the water pockets to reach the side ditches, no matter how deep.

Shoring Necessary

Many of the test holes have had to be extended from the track in the form of trenches to permit drainage into the side ditches and thus enable the men to work, and, in most cases, some shoring has had to be resorted to to support the sides of the holes. However, because of the stiffness and tenacity of the clay, especially when mixed with the stone ballast forced down into it, the necessity for shoring has been confined largely to the depth of the loose ballast section.

One of the Mats, Ready to Be Backfilled —Showing Also the Rail Type of Track Stringering Employed

The particular type of shoring used in this work consists of two 26-in. by 48-in. sheets of corrugated iron, laid lengthwise in the holes and held apart at the front end by a shorter section of the sheeting slid down between pairs of 1-in. angles welded to the inside faces of the side sheets. At the rear end, the side sheets are held apart by means of trench jacks. Assembled in the ballast between tie ends, close to the rail, where a hole is to be dug, the shoring is tapped down as the excavation progresses. This continues until the tops of the shoring plates reach a level just below the bottoms of the ties. This method of shoring has been found particularly effective since the material used is handled readily, occupies a minimum of space and can be used repeatedly. Just as soon as a test hole is completed and the measurement to dry subgrade has been taken, clean material is put back in the hole and is thoroughly compacted by tamping.

The Next Step

Having prepared a subgrade profile, the next step has been to drain the low spots and restore the supporting power of the subgrade clay in these areas. In the work under consideration, the Pennsylvania is employing timber mats beneath the tracks, laid on a 12-in. cinder cushion, and the cross-trench is then backfilled with clean cinders, above the mat, to the normal stone ballast level. The bottom of the cross-trench, after being graded to a smooth surface, is first covered over with a thin layer of quick-drying waterproof material.

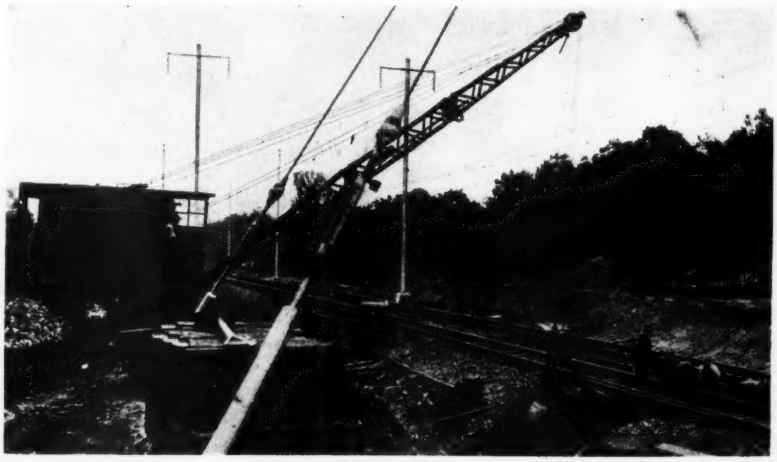
The timber mats are buried in the subgrade and are pitched from a point six inches below the lowest point in each pocket to the adjacent side ditch. Where possible, the mats extend into the open ditch, but where the depth of the ditch is limited by local conditions, which is usually the case, they are made to extend into a wooden box drain buried longitudinally in the ditch, which carries the water to natural water courses. The theory behind the cinder and mat construction is essentially that the cinder cushion, with the heavy timber mat serving as a stabilizer, will provide and preserve positive and permanent lateral drainage from the water-pocket to the side ditch, and will spread the track load over the new surface of clay subgrade so as to maintain the smooth pitch and prevent development of a new pocket in the bottom of the cross-trench.

The mats, which are made four feet wide, are provided at each low spot in the subgrade profile where there is any possibility that water will collect and be retained, and are spaced as close as 15 ft. center to center, if necessary. This distance is considered a minimum in view of the conditions being found generally, and also because of the belief that with this spacing, adequate drainage will be afforded to the area between the mats.

As a general rule the mats are made to extend under only one track; that is, each track is drained laterally to its adjacent side ditch. This is because the location of the water pockets in one track generally bears no relation to the location or spacing of the pockets in the other track, and the further fact that to attempt to drain both tracks from one side would, in almost every case, require the placing of the mats and the one side ditch box much deeper, with the difficulty and added expense which this would entail. An exception to this general practice was carried out at one location, where, because of the character of the material in the subgrade and the limited space available for opening up deep side ditches, the cross drains and mats were pitched to a box drain laid deep in the center ditch between tracks.

The mats employed consist of two thicknesses of 3-in. by 12-in. creosoted pine plank, securely spiked together, the bottom layer being laid lengthwise of the cross drain and the top layer at right angles to it. All of the planks are laid tight, edge to edge, and, to facilitate the flow of water away from the track, the mats are given a substantial pitch toward the side ditch. In all cases the mats extend beneath the full width of the track.

The impracticability or impossibility of providing open side ditches of sufficient depth to carry off the water from the low outlet ends of the track cross drains led to the provision of rectangular wood box manholes at the ends of the mats, connected longitudinally through the line of the ditch by wood box drains. The manhole boxes, the bottoms of which are placed well below the bottom of the cinder course beneath the timber mats, are constructed of creosoted timber, generally pine purchased for the purpose, although some fit treated car lumber has been used. The boxes are 12 ft. long and have a clear inside width of 22 in. The height of the boxes depends upon the depth of the cross trench drains and the grade of the finished side ditch, since the tops of the different boxes are brought up to the final permanent ditch level. In constructing the boxes, 3-in. by 8-in. plank are used in the sides, bottom and cover, about inside frames made up of 4-in. by 4-in. timbers.



Crawler-Type Cranes with Clam Shell Buckets Do Much of the Excavation for the Cross Trenches and Side Ditch Boxes

Special features of the boxes are that the siding planks are spaced one inch apart, affording open joints to permit the ready entrance of water; the use of wrought iron cut nails and spikes in their assembly because of their resistance to corrosion; and the fact that the boxes themselves are non-collapsible, independent of the holding power of the spikes used, as a result of dapping of the joints of the frames. Further interesting features of these boxes are the timber grating provided over the area of the inlet from the cross trenches, and the fact that the sides and ends are backfilled with at least six inches of cinders. Since the tops of the high manhole boxes are at the finished ditch line, the plank covers can be removed readily when desired to permit the entrance of a man for cleaning.

The smaller box drains which connect the manhole boxes are similar in construction to the manhole boxes and of the same width, but they are generally not over 23 to 25 in. high. This, however, provides a waterway in excess of any drainage requirements and, at the same time, permits ready cleaning if necessary. Various classes of pipe have been used to join the manhole boxes in certain minor installations, but the use of pipe is now being confined to the ditch subdrainage lines beyond the sections of track being cross drained. This is thought desirable since the use of the wood box drains within the section of track being dried up permits the ready connection of additional cross drain mats in the future if such should become desirable. It is also thought that the box drains are more stable under the ground conditions encountered. In every case, the outlets of the longitudinal side ditch subdrains, whether boxes or pipes, are provided with concrete head walls of adequate size and design to prevent erosion of the surrounding material.

Installation

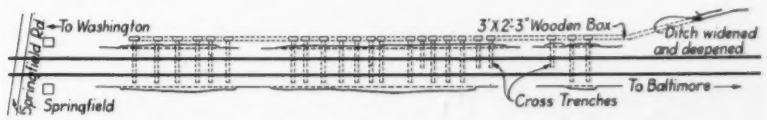
In installing this type of drainage system, the first operation is to excavate for and construct the side ditch drain boxes, working from the low point in the system. Then, as the locations of the cross trench drains and mats are reached, the necessary excavations are made for these. Most of this excavation is done by cranes with ¾-yd. clamshell buckets on crawler-type mountings, which are operated along the top of the cuts. These cranes are also used to unload from cars the cinders required for backfilling the cross trenches and side ditch boxes.

Excavation directly beneath the tracks is made with hand shovels, ballast forks and pneumatic spaders. Power spades are also used in cutting back and straightening up the side walls of the trenches, and have been found of special help because of the toughness of the clay formation, especially when dry. The sides of the cross trenches are shored up with planking held in place by trench jacks, although shoring is not necessary in the side ditch trenches except in unusually wet weather.

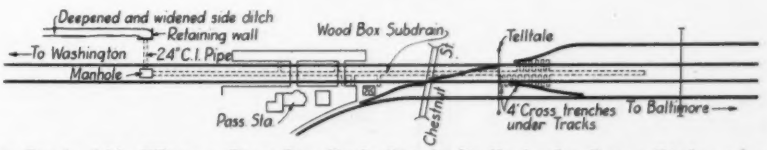
The excavating of the four-foot cross trenches requires that the track be carefully stringered to permit normal train operation. This led to the development of a rail-type stringer which has proved effective and more economical than the usual method of timber stringers. In this method, a 27-ft. length of 130-lb. rail is laid immediately outside each running rail, and two 12-ft. lengths of 152-lb. rail are placed, head up, beneath the ties, at each end, with the inner rails directly beneath the track rails, and the outer rails directly beneath the top stringer rails. The bottom rails on each side are supported at their ends on 10-in. by 16-in. by 30-in. blocks, and such adjustment as is necessary to keep the track in good surface is made with oak wedges. To insure unit action in the rail stringers and to guard against their accidental displacement, the top stringer rail and the outside bottom rail on each side are clamped together securely by means of five U-bolts, made of one-inch round bars. These rail stringer assemblies, which are put in before the cross trenches are excavated and removed after the trenches have been backfilled and tamped thoroughly, are moved from one location to another and used repeatedly.

tions by the addition of stone ballast and repeated surfacing. In common with conditions found at practically all of the wet spots on the divisions, the water level remained relatively close to the ties and the wet soft clay was constantly squeezing out into the side ditches, leading to the gradual settling of the tracks. Any attempt to remove this material to free or lower the ditches only aggravated the squeezing action and increased the track settlement.

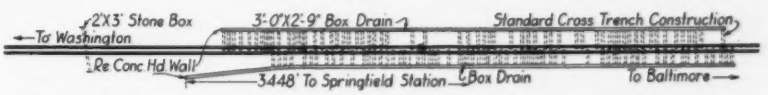
At "Coffee Cup" cut, where the unstable condition existed for approximately 1,000 ft., 56 water pockets were drained. Here, it was found that most of the pockets beneath the tracks lay opposite or practically opposite each other. This made it practical to tap most of the pockets beneath both tracks from one side with double-track cross trenches and mats. This was done, so that at this point, 25 double-track trenches and 6 single-track trenches were provided, all draining to a single wood box subdrain installed beneath the west ditch.



Plan of the Major Group of Cross Drains Installed in "Coffee Cup" Cut, North of Springfield, Md.



At Bowie, Md., Where a Deep Box Drain Longitudinally in the Center Ditch, and a Few Cross Drains, Completely Remedied a Bad Wet Condition



Sketch Plan of the Hickory Hill Installation, Which Includes 101 One-Track Cross Drains and Mats

Three Examples

Of the 21 or more points on the Baltimore and Maryland divisions where the mat-type cross drains have already been installed, three of the largest and most interesting installations, illustrating the different arrangements used, are just north of Springfield, Md., in what is known as "Coffee Cup" cut; at Bowie, Md., directly through and north of the station area; and at Hickory Hill, beginning about 1,200 ft. south of the Springfield station. At all three of these points, in cuts and on grades of 0.7 per cent or more, the tracks had remained wet and unstable in spite of repeated efforts to dry them up by side ditching, and to stabilize condi-

At Bowie, the wet track condition existed from the passenger station to a point about 1150 ft. north of the station in the vicinity of a group of turnouts. Here, because of a sandy subgrade and lack of room in the side ditches, complicated by the station platforms and certain railroad buildings, a single box drain, 1500 ft. long, was provided through the center ditch between tracks, and then extended laterally by pipe beneath the southbound track to an open ditch just south of the station. In the vicinity of the turnouts, 14 four-foot mats were installed, 6 extending beneath the southbound track and 8 beneath the northbound track. Five

similar mats were also provided at isolated wet spots nearer the station. Throughout the length of track embracing the mats, approximately 950 ft., the center ditch box drain was made 2½ ft. wide by 6 ft. high, with the cover generally only 6 in. below the level of the bottoms of the ties. North and south of this high box, a box section 2 ft. 6 in. wide by 2 ft. 8 in. high was employed as amply sufficient to drain the tracks.

At Hickory Hill, where the sub-drainage work was completed recently, the installation extends over a distance of approximately 2100 ft., and involves a total of 101 one-track cross trenches with mats. Of these, 48 extend to a box drain in the east ditch and 53 to a similar drain in the west ditch. Here, as evidenced by the clay profile beneath each track, there was no relation between the water pockets beneath the two tracks. Hence, it was found considerably more economical and practical to construct box drains in both side ditches, with the necessary cross trenches reaching only beneath the adjacent track, than to provide a drain in only one of the ditches and incur the largely increased expense of the many two-track cross trenches that would have been required to reach the pockets beneath both tracks. This is the arrangement that is most frequently found advisable, especially where there are a large number of pockets under both tracks within a relatively limited distance.

As a matter of economy, the 12-ft. timber manholes which have generally been provided at the ends of the cross trenches at other points, were left out at Hickory Hill. In their place, six-foot timber manholes, similar in construction to the larger boxes, were provided in each side trench at intervals of about 100 ft. It is expected that this arrangement will prove entirely satisfactory, especially since the continuous drain laid in each ditch is 3 ft. wide by 2 ft. 9 in. high, affording adequate room for cleaning and for the entrance of a man if necessary.

Other Factors

In conjunction with the sub-drainage of the water pockets, other factors to improve surface drainage and the stability of the tracks have been given consideration. For example, supplementary pipe sub-drainage installations have been made beneath the side ditches at various points, notably at Bowie, where the box drain was installed beneath the center ditch. Standard ditches have been provided over the boxes installed beneath the side ditches. The outside track shoulders have been built up to standard width, and the side slopes of the cuts have been flattened where necessary to minimize sloughing off into the ditches. In fact, most of the cuts have been widened materially to improve the ditch and side slope conditions. Furthermore, the side slopes of the clay cuts, which of themselves will support only meager vegetation, have been covered with mushroom soil, a rich discarded manure from mushroom houses, and then planted with grass, oats and honeysuckle vines as a means of preventing erosion.

Without exception, where the drainage methods described have been applied on the Baltimore and Maryland divisions, they have cleared up the wet and unstable track conditions. Sections of track that were formerly untidy, where ditches could not be maintained and where joint or general track surfacing had to be done to some extent at least once a week, have gradually dried up and become as stable as the track elsewhere.

The expense involved in making these extensive drainage installations, amounting to approximately $300 per cross-drain per single track, is considered amply justified by the improvement in track conditions and the large saving in maintenance expense. That this is the feeling on the Pennsylvania is evidenced by the sizable program that has been carried on during the last two or three years of relatively lean earnings, and by the further fact that the road has tentative plans for employing this method at a considerable number of additional points which have stubbornly resisted drainage by other methods.

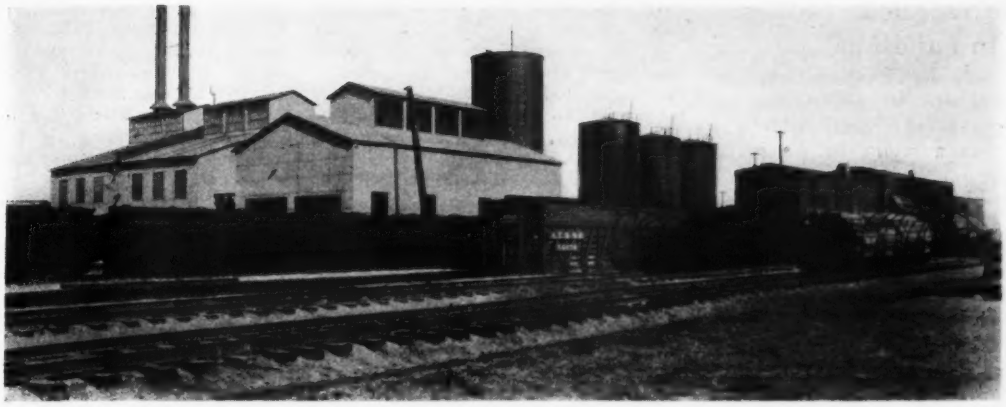
The work described has been carried out under the general direction of Robert Faries, assistant chief engineer, maintenance, of the Pennsylvania, and W. T. Covert, chief engineer maintenance of way of the Eastern region, while the installations have been made by company forces under the direct supervision of the division maintenance officers.

Work Under Way at Hickory Hill, South of Springfield, Md., Where 101 Mats Were Installed to Drain Water Pockets

Defective Crossing Figures in Derailment

THAT poorly maintained highway crossings may lead indirectly to serious accidents is revealed in a report of W. J. Patterson, director of safety of the Interstate Commerce Commission, concerning the derailment of a passenger train on the Pennsylvania on September 29, 1934, which resulted in the death of the fireman and engineman and the injury of 12 others. The derailment, which took place in double-track territory at Convoy, Ohio, at 12:30 a.m., occurred when the locomotive struck an automobile that had become stalled on the track at a highway crossing.

The crossing, which crosses the track at a sharp angle, is of asphalt construction, 17 ft. wide, with timber curbs. According to the report, the surface of the crossing was uneven and at some points was more than 3 in. below the tops of the rails, while the intertrack space adjacent to the crossing was more than 1½ ft. below top of rail. When the automobile started across the tracks at this crossing, the rear wheels skidded against the rails, which were wet with rain, and the rear end of the car was forced off the crossing into the intertrack space.



Sante Fe Timber Treating Plant, Wellington, Kan. An Example of a Modern Plant

Treating Timber Better

Wood-Preservers study service records of railway materials at meeting in New York

RAILWAY uses of treated timber occupied a prominent place, as heretofore, in the program for the thirty-first annual convention of the American Wood-Preservers Association in New York City on January 22-24. H. R. Clarke, engineer maintenance of way of the Chicago, Burlington & Quincy, reviewed the experience of that road in the treatment of 61,650,000 crossties during the last 35 years. George Rear, engineer of bridges of the Southern Pacific, Pacific System, presented a résumé of 45 years' experience of this road in the treatment of timber for more than 160 miles of trestle-type structures. Dr. Herman von Schrenk, consulting timber engineer, St. Louis, Mo., presented an address on the treatment of piling and timber for tidewater structures as a protection against attacks of marine borers. Committees also presented service records of treated ties, piles and other timbers in railway use. The papers by Mr. Clarke and Mr. Rear are abstracted elsewhere in this issue. That of Dr. von Schrenk will appear in a later issue. Abstracts of other papers and reports follow.

In a brief report by the Committee on Diversified Uses of Treated Wood, of which E. P. Gowing of the American Creosoting Company was chairman, a recommendation was offered to the effect that lumber and timber for interior use, which have been treated with zinc chloride, should be dried by air seasoning or kiln dried to have a moisture content of not more than 25 per cent, before installation. In discussing this paper, R. S. Belcher, A.T.&S.F., advocated the more general use of wood treated with zinc chloride in the interiors of railway station buildings.

Further progress in the investigation of the resistance of creosoted piles to destruction by teredo and limnoria was reported by the Committee on Marine Piling Records, of which M. F. Jaeger, superintendent of the Port Reading creosoting plant of the Reading-Central Railroad of New Jersey, was chairman. In the main, the report comprised a compilation of observations made in the course of inspections of 10 docks, bridges and other tidewater structures between Seattle, Wash., and Charleston, S.C., including a number constructed and maintained by railways.

Tie Service Records

The Committee on Tie Service Records (W. R. Goodwin, engineer wood preservation, Soo Line, chairman) presented its annual tabulation of tie renewals on 27 railways, showing the average renewals per mile and the "five-year averages" for the years 1911 to 1933, inclusive, as well as the corresponding figures for the combined mileage of these 27 roads. The figures for 1933 are reproduced below:

Railway	Average Renewals 1933	Per Mile Five-Year Average
A.T. & S.F.	76	120
B. & O.	73	91
B. & M.	75	165
C.R. of N.J.	45	72
C. & E.I.	92	104
C. & O.	85	132
C.B. & Q.	64	125
C.I. & L.	63	108
C.C.C. & St. L.	61	77
C.M.St.P. & P.	133	207
C.R.I. & P.	45	95
D.L. & W.	48	66
G.N.	40	149
I.C.	96	150
K.C.S.	121	146
L.V.	63	56
M.C.	34	68
M.St.P. & S.S.M.	169	193
M.K.T.	98	138
N.Y.C. (East)	57	91
N.Y.C. (West)	40	55
N.P.	96	114
Penna.	50	89
Reading	24	80
S.P. Atl. Sys.	81	134
S.P. Pac. Sys.	57	133
U.P.	86	112
All 27 Roads	73	120

In addition to the tie renewal records, the committee presented tabular summaries of data obtained in the 1933 inspections of test tie installations on the Burlington, the Lackawanna, the Santa Fe and the Rock Island and a progress report of a test being conducted on 3,800 ties in a track of the Milwaukee at Madison, Wis.

Use of Creosoted Wood in Buildings

Experience with creosoted wood in buildings devoted to such use that the odor might prove objectionable was discussed in a report by a Special Committee on the Use of Creosoted Wood in Residences or Other Buildings. The committee, of which George M. Hunt of the Forest Products Laboratory, Madison, Wis., was chairman, offered specific conclusions that embrace valuable suggestions on the use of creosoted wood in buildings in such manner as to avoid odor, staining or other troubles.

This study was based in part on some 80 individual reports covering experience with an aggregate of 273 buildings in which creosoted wood had been used for sills, joists, subfloors and similar structural elements that are ordinarily concealed from view. Included among these buildings were a number of stations, tool houses, bunk houses and other railway structures. In such buildings, according to the committee, the odor of creosote would seldom be objectionable, and no reports of unsatisfactory service were received. With respect to the buildings as a whole, the committee reports the following general observations.

The majority of the replies received to date state that no odor was noticed or that the odor disappeared in a short time. Usually the occupants of the building did not consider the odor objectionable. On the other hand, a few cases were reported where the odor persisted longer than three months, and in two replies it was reported that serious trouble had occurred as a result of creosote bleeding from the wood and dripping into the basement, or staining flooring or plaster.

The conclusions of the committee, which include some valuable suggestions on the manner of using creosoted wood in buildings to minimize objectionable results, are as follows:

Conclusions

1. It is practicable to use creosoted wood in residential buildings up to and including the first sub-floor, without appreciable odor or other disadvantage, provided reasonable precautions are taken.

2. When odor is noticeable it is usually slight and generally disappears within a few months. The slight odor that may be noticed is not objectionable to the average occupant, especially if the occupant is the owner and interested in the protection of the building from decay and insects. It may be objectionable, however, to persons who are sensitive to odors.

3. Odor is most noticeable in basements, or other enclosed spaces containing creosoted wood, that are not adequately ventilated, or in buildings that have been closed and unused for some time.

4. The following precautions should be observed in using creosoted lumber in residential and similar buildings when it is desired to avoid odor, staining or other troubles, or reduce them to the minimum:

a. Do not use heavily treated material. An absorption of 8 lb. per cu. ft., injected by an empty-cell process, appears to be high enough for protection and low enough to avoid trouble.

b. Do not install lumber that is wet with creosote or fresh from treatment. Allow it to air season sufficiently to dry the surface before building the lumber into the structure.

c. Do not face nail finish lumber to creosoted lumber, for creosote may follow the nails through the finish lumber and produce creosote stains at the nail heads. This staining may be avoided by blind nailing or by using untreated nailing strips over the creosoted wood and applying the finish lumber with nails that do not reach through to the creosoted wood.

d. It is unsafe to use creosoted wood under plaster, especially when the plaster is applied over wood lath nailed directly to creosoted studding. If creosoted wood must be used under plaster, contact between creosoted wood and plaster must be avoided or the plaster may be stained.

e. Since no method of painting, varnishing or waxing has been developed for use with creosoted wood, that is acceptable for residential buildings, creosoted lumber should not be employed in residential buildings where its surface is required to be so finished.

f. Avoid the circulation of heating, cooling or ventilating air through enclosed spaces containing the odors of creosoted wood.

g. Avoid placing creosoted wood where it will be heated. When creosoted wood must be used close to furnaces, hot pipes, or radiators, provide insulation that will prevent the heating of the wood and the production of creosote fumes.

h. In basements, it is best to leave creosoted wood exposed to view, unless it is especially desired to eliminate all odor or to cover up the creosoted wood for the sake of appearance. Applying untreated wood or wall-board over the creosoted wood will mask the odor, but it must be done in such a way as to avoid exposing the untreated material to decay or insects. If only part of the space beneath a building is excavated and used as a basement, odor from the unused part may be excluded by suitable walls or partitions.

i. While the committee has no records on the effectiveness of applying paint, varnish, shellac, sodium silicate or other coatings to creosoted wood for the purpose of eliminating odor, it is believed they would be highly effective even though they might be unattractive in appearance.

Saving a Million Crossties

(Continued from page 78)

tie renewal statistics on the Burlington, and observations of tie performance on other roads, confirmed so far as possible by a check of the present condition of about 50,000 test ties of various kinds, that were treated in several ways and have been installed in a number of locations at different times since the first test lots were put in track in 1909 and 1910, it was decided that a further change in treating processes was economically justified.

The method of treatment recommended was the Reuping process, using a mixture of 50 per cent creosote and 50 per cent petroleum, with a retention of eight pounds per cubic foot of wood. It was further recommended that all ties be pre-adzed and bored before treatment and that such timber be incised as required it to secure proper penetration. It was proposed also that the size of tie plate for heavy duty lines be increased to 8-in. by 11-in. and provided with a double shoulder, rolled in crown.

The expenditure involved and the ultimate saving that might conservatively be expected were carefully weighed. The expenditure was actual, definite and immediate. The saving was, necessarily, but a careful estimate and was to be realized in the future. As in 1900, the Burlington has executive officers with foresight and courage. The capital investment

Average Life of Untreated Ties

Kind	Average Years
Cottonwood	2.9
Sycamore	3.3
Tupelo Gum	3.5
Red Birch	3.6
Soft Maple	3.6
Red Gum	4.1
Hard Maple	4.7
Hemlock	4.9
Beech	5.0
Ash	5.1
Tamerack	5.1
White Elm	5.3
Loblolly Pine	5.3
Red Oak	5.3
Poplar	5.3
Hickory	5.5
Pin Oak	6.3
Cyprus	8.3
Chestnut	9.7
White Oak	11.1

for equipment and machinery was made, the more expensive method of treating ties and the increased expenditure for larger tie plates were authorized.

We have been supported and even encouraged on by our executive officers to insist on the purchase of ties up to specifications in size and quality. We confidently expect to secure from such ties, well treated and properly protected, a service life of 25 years. If this service life is obtained, the comparison of these 25-year ties (based on 1933 costs) with the 18½ year record established will be as follows:

Annual cost 18½ year tie	$0.1912
Annual cost 25 year tie	0.1642
Annual saving per tie	0.0270

With 39,300,000 ties in track, this saving will amply justify the increased expenditure, just as the practice started in 1899 has been so clearly proved to have been right.

Discussion

In a discussion of this paper, W. A. Summerhays, manager forest products inspection and research bureau, Illinois Central, cited among the problems remaining to be solved the determination of proper ways of seasoning and otherwise developing the possibilities for using local woods, such as, on his line, the lowland red oak of Louisiana. J. F. Dobson, assistant engineer maintenance, B. & O., stated that his road, like the Burlington, had found it more economical to substitute oil treatment for the Card process in the preservation of ties.

More Roads Make Track Awards

THE Delaware & Hudson, the Chesapeake & Ohio and the Pennsylvania have announced the results of their annual track inspections for 1934, abstracts from which, with the names of the supervisors and foremen receiving the highest recognition, are given below. The results of the annual track inspections on two other roads, the Erie and the Norfolk & Western, were announced in January.

C. & O. Awards $1,850

As a result of the annual track inspection on the C. & O. in 1934, 14 track supervisors and 62 foremen received cash prize awards totaling $1,850. In order to equalize conditions over the system, the tracks of the road were divided into five groups. First, second and third prizes of $50, $40 and $30, respectively, were awarded to the supervisors; first and second prizes of $25 and $15, respectively, were also awarded to two foremen on each supervisor's territory; and two special "improvement" prizes of $50 each were awarded to two supervisors on the system. The names of the supervisors who won the awards follow:

Group 1—First prize—J. L. Brightwell, Huntington district; second prize—J. H. Poindexter, Peninsula subdivision; third prize—L. E. Crance, Alleghany subdivision.

Group 2—First prize—R. R. Burchett, Barboursville district; second prize—O. M. Smith, Logan district; third prize—F. P. Barrick, Paintsville district.

Group 3—First prize—R. H. Gibson, Mountain subdivision; second prize—S. Ryan, Chicago district.

Group 4—First prize—B. Jackson, Coal River district; second prize—J. A. Bragg, Cabin Creek district.

Group 5—First prize—F. A. Dirnberg, Maumee district; second prize—J. W. Knapp, Jr., Russell division.

The improvement prize awarded supervisors of Groups 1 and 2, jointly, was won by O. M. Smith, who also won the second prize in Group 2; the similar prize awarded supervisors in Groups 3, 4 and 5, jointly, was won by J. C. Runyan, Cincinnati Terminal district.

D. & H. Makes Cash Awards

Twenty-nine foremen on the Delaware & Hudson received cash prize awards totalling $1,605 as a result of ratings based upon the physical condition of the tracks and rights-of-way of the various territories, and the efficiency with which the work was handled on each during the year. System prizes of $50, $25, and $15 were awarded to three main-line foremen; system prizes of $100, $75 and $35, to three branch-line foremen; division prizes of $100, $60 and $35, to three main-line foremen on each of the four main divisions; system prizes of $100, $75, and $50, to three yard foremen; and division "improvement" prizes of $50 and $25, to two foremen on each of the four divisions. The names of the foremen who won the first prizes are given below.

Best main-line section on the system, H. Willette, Champlain division, South Junction, N. Y.; best branch-line section on the system, A. Valenze, Champlain division, Lake Placid, N. Y.; best main-line section on the Champlain division, H. Willette, who won the first system main-line prize; best main-line section on the Saratoga division, F. Parillo, Ballston Spa, N. Y.; best main-line section on the Susquehanna division, L. Sandike, Wells Bridge, N. Y.; best main-line section on the Pennsylvania division, D. Cicio, Jermyn, Pa. The first prize for the best-maintained yard on the system was won by T. Pasquarell, on the Susquehanna division, at Schenectady, N. Y. The first prizes on the different divisions for those sections showing the greatest improvement during the year were awarded to A. Alphonse, Champlain division, at Lyon Mountain, N. Y.; C. Lando, Saratoga division, at Comstock, N. Y.; A. Altieri, Susquehanna division, at Schenectady, N. Y.; and C. Vandenburg, Pennsylvania div., Windsor, N.Y.

Pennsylvania Commends Men

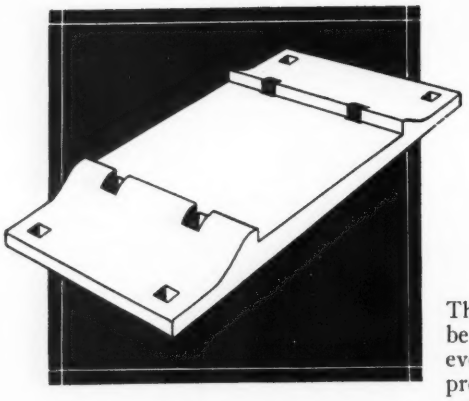
Continuing its long-standing practice, the Pennsylvania, throughout 1934, made periodic track inspections of all of its tracks, and at the end of the year sent letters of commendation to those supervisors and foremen whose territories received the highest ratings on the different divisions or subdivisions. Following are the names of the supervisors and their assistants (where they have assistants), whose territories received commendation.

New York Zone—New York division—J. J. Clutz, Trenton, N. J.; Abram Fulkerson (assistant). Long Island Railroad—Lee Spencer, Woodside, L. I.; J. C. Wardlaw (assistant).

Eastern Region—Best of all main-line supervisors' subdivisions between Philadelphia and Altoona, and between Darby (Philadelphia), Pa., and Washington, D. C.—J. P. Newell, Maryland division, Wilmington, Del.; L. W. Green (assistant). Middle division—J. D. Morris, Newport, Pa.; G. C. Vaughan (assistant). Philadelphia division—M. C. Bitner, Lancaster, Pa.; A. R. Mahaney (assistant).

Central Region—Pittsburgh division (main-line)—C. R. Sanders, Trafford, Pa.; A. B. Lewis (assistant). Pittsburgh division (branch line)—M. J. Miller, Barnesboro, Pa. Conemaugh division—W. P. Critchfield, Blairsville, Pa. Monongahela division—O. L. Fisher, Youngwood, Pa. Eastern division—D. E. Callahan, Pittsburgh, Pa. Panhandle division (main-line)—J. C. Dayton, Newcomerstown, Ohio. Panhandle division (branch line)—W. P. Geiser, Wheeling, W. Va. Buffalo division—Carl McGhee, Struthers, Pa. Renovo division—L. M. Woodward, Kane, Pa. Cleveland division—J. Conlon, Alliance, Ohio. Erie and Ashtabula division—L. C. Martoia, Niles, Ohio.

Western Region—Best of all main line supervisors' subdivisions—A. F. Roper, Cincinnati division, Marrow, Ohio. Fort Wayne division—Charles Weiss, Valparaiso, Ind. St. Louis division—J. F. McKinney, Terra Haute, Ind. Columbus division—D. Lewis, Richmond, Ind. Chicago Terminal division—P. W. Triplett, Chicago. Logansport division—John Nowviskie, Crown Point, Ind. Toledo division—C. V. Frish, Carrothers, Ohio. Grand Rapids division—J. H. Ault, Petoskey, Mich. Indianapolis division—W. W. Clarke, Jeffersonville, Ind. Cincinnati division—Paul Reeves, Cincinnati, Ohio.



Can Tie Plate

TIE PLATES provide ample evidence that individualism in design, which was so prominent a characteristic of track materials a half century ago, has by no means been abandoned by railway engineers today. Seemingly one of the simplest of track accessories, one might expect this device to be characterized by few designs having a limited number of variations. Yet no supposition could be more at variance with the facts, for there is no device used in track construction today for which there is a greater multiplicity or a wider range of designs. Nor is there any other for which the designs are changed so frequently.

In support of this statement, one manufacturer is rolling currently 54 distinct designs of tie plates; another is producing tie plates of 80 separate sections; a third is maintaining rolls for 91 different designs; while a fourth has live rolls for 107 sections, practically all of which have been used within the last year; and the current rollings of still another mill represent "well over a hundred different designs."

Situation Confusing

Although these facts taken alone are arresting, they give only a faint idea of the confusing situation with respect to tie plate design today, which does not differ greatly from that which characterized rail design 50 years ago, both as to multiplicity of designs and frequent changes of design. Two examples will suffice to illustrate this situation, which has not developed recently but is of long standing. Since 1914, one mill has rolled tie plates of 230 different sections to which 2,054 separate punchings have been applied, an average of 9 different punchings for each section; while at another mill, during the same 20-year period, the combinations of sections and punchings have totaled more than 5,000, an average of more than 250 a year. These are not isolated cases, but can be repeated with little variation for every mill where tie plates are being produced.

Obviously, a tie plate for use with a rail weighing 131 lb. to the yard will differ from another for 90-lb. rail or still lighter sections. It is not so clear, however, why one road has considered it necessary to change its design for tie plates every year for eight years, when it has made but one change in rail section during that time, and this for the purpose of using a heavier section on its most important main lines. It is equally difficult to understand the considerations which led another road to change its design annually during the last three years, although it has not changed its rail section and has laid practically no rail during this time.

This is the fourth article of a series dealing with the multiplicity of designs in track materials and tools. In the first article, in the November issue, the general problems of standardization were set forth. In the December and January issues, respectively, specific problems connected with rail and with track wrenches and their standardization were discussed. The present article deals with tie plates and the problems facing railways and manufacturers by reason of the multiplicity of designs of this seemingly simple device.

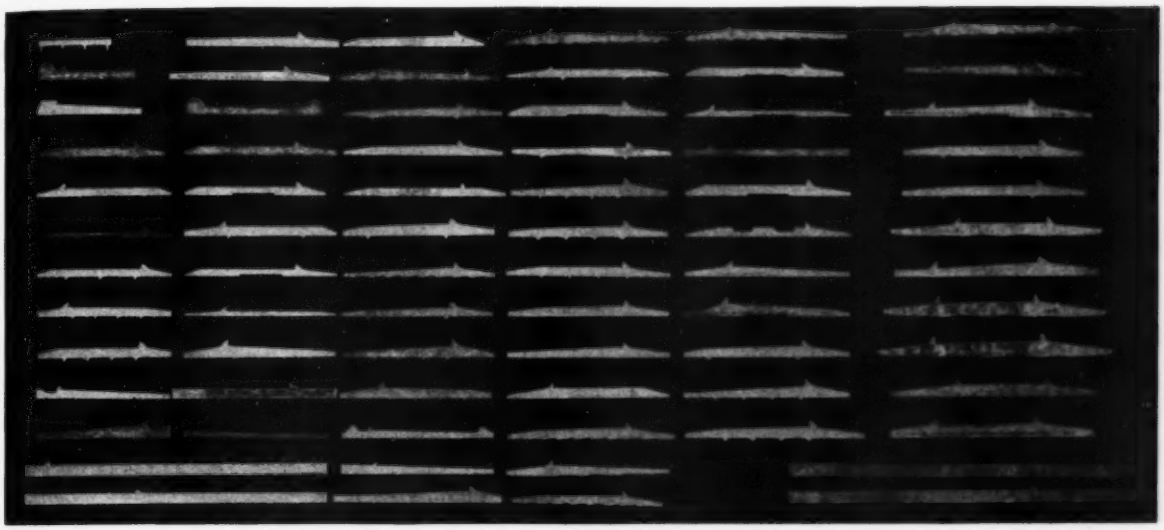
It is not uncommon for individual roads to specify from two to five different designs of tie plates in a single order. If each of these designs was intended for use with a single weight of rail, it would be easy to understand the reason for this requirement. But when the punchings indicate that one design is to be used with several weights of rail while at the same time several of the designs are also intended to be used with a single weight of rail, the reasons become obscure. As an illustration of this practice, one road recently placed an order for four different designs of tie plates, for which it specified 12 separate punchings, only one of which had been used previously. In contrast, another road is using a single design of tie plate for all weights of rail, varying the punching only as necessary to fit different rail bases. Still another road has developed a single design of tie plate for use with its four different rail sections, for which 14 different punchings are required.

These facts are sufficient to show that there is a multiplicity of designs for tie plates and that these designs are subject to frequent change. As with all other track materials and with track tools, however, a study of tie plate designs discloses that many of the differences are confined to minor details. In other cases, the differences, although small, may be of considerable or fundamental importance. As to the former, it would not seem to be particularly important whether the height of the shoulder is 3/8 or 13/32 in. On the other hand, a variation of as little as 1/4 in. in the location of the shoulder may be of considerable importance.

A study of approximately 50 designs of tie plates for use with 100 and 110-lb. rail, disclosed five widths ranging from 6½ to 8¾ in.; while there were nine lengths, from 9 to 11⅛ in., for use with 100-lb. rail, and five lengths, ranging from 9½ to 11⅛ in. for the 110-lb. section. In the same group the eccentricity varied from 3/8 in. to 3/4 in., some of the intermediate increments being as small as 1/64 in. Likewise, ten differences were found in the height of the shoulder, which ranged from 1/4 to 3/4 in., in some instances by increments as small as 1/64 in.

As a matter of comparison, another group of approximately the same number of designs was also studied. In this case, however, some of the plates were for use with 112-lb. rail as well as with the 100 and 110-lb. sections which comprised the first group. In this group, seven

Be Standardized?



Courtesy Bethlehem Steel Company

Sections of a few of the Designs Being Rolled Currently by one Manufacturer

variations were found in the height of the shoulder, ranging from 3/16 in. to 9/16 in., while the smallest difference between two shoulders was 1/32 in. Six widths were found in this group, from 6 in. to 9½ in.; and 10 lengths, from 8½ to 14 in.

Study of 100 Designs

In the two groups, comprising approximately 100 different designs, there were 20 variations in the distance from the shoulder to the outer end of the plate, ranging from 2 in. to 3¾ in., with a number of the designs differing by only 1/32 or 1/64 in. Likewise, there were 25 variations in the length of the gage end, the range in this dimension being from 1 in. to 3⅞ in., with the smallest difference 1/64 in.

Of late, it has become a general practice to give the rail a slight inward cant. The two groups of tie plates under study indicate, however, considerable difference of opinion as to the amount of cant that should be given, since there were nine variations in this feature of the design, ranging from flat to 1:20, with intermediate designs providing for cants of 1 in 88, 44, 43, 40, 37, 29 and 24, respectively.

Only a few of the many variations found in the different designs of tie plates have been mentioned. Among those not already pointed out, bottoms may be flat, ribbed or have various forms of corrugations to reduce the probability of horizontal movement with respect to the tie or to reduce the weight of the plates. Even in the simple matter of ribs, variations are found in the number, spacing, depth, width and shape. In fact, out of 35 ribbed plates in the two groups, there were 30 different designs with respect to spacing and shape. Again, the two groups of tie plates contain 26 different designs for the shoulders, this number being increased still further by the fact that several of the designs are applied to shoulders of different heights. In some instances, the bottom of the plate is given an upward slant of from 1/32 to 1/16 in. beginning 2 to 3 in. back from the ends; in other designs the bottom edges at the ends are given a sled-runner curve, so that the ends of the plates have an under-cut appearance.

Of late, an increasing number of roads are demanding cambered rail seats on their tie plates. These are obtained in either of two ways—by rolling in a crown or by pressing the camber in the plate. Here again, variations in design are beginning to creep in, as the roads are calling for different amounts of camber, although different designs also apply the same absolute camber to plates of varying width. In some cases only the amount of rise at the center of the plate is specified; in others the crown is required to conform to the arc of a circle of given radius. In view of the variation in the width of the plates to which the camber is applied, it would not seem to be important whether the absolute camber is 1/16 in. or 5/64 in., or whether the radius of the circle is 10 ft. or 10 ft. 4 in.

Service Not Affected

Not all of the variations in design, even in the two groups of tie plates studied, have been mentioned. Enough has been given, however, to show that there is not only a multiplicity of designs, but that many of the variations are so small, or occur in such unimportant details, that they do not in any way affect the service life or value of the plates. In fact, it is difficult to understand why some of the differences have been introduced, since a comparison with some of the sections which have been replaced by later designs, in-

dicates that on some roads many of these minor details have been changed in successive designs.

While the number of variations in the design of the tie plate section is large, these variations are overshadowed by the greater number of differences that are found in the punching of the plates. In fact, there are so many variations in the punching that they can be pointed out only in a general way. Some plates are punched for only two spikes, others have four spike holes, while several designs were noted in which the punching was for three spikes. In the four-hole punching it is the usual practice to locate the spike holes so that they fall at the corners of a square or rectangle. On the other hand, some roads stagger the holes so that no two are opposite. Again, certain roads require the punching to have square corners, while others specify rounded corners. As a further variation, some of the holes are straight while others are tapered slightly.

As many variations occur in the staggering of the spike holes, that is, the spacing longitudinally of the rail, this dimension ranging from 2 in. to 5 in. in plates designed for the three weights of rail previously mentioned. It is also interesting to note that not a few of the spacings within this range differ by only 1/16 in., while in several cases the differences are measured in thirty-seconds of an inch. It might be expected that for a given section of rail, the transverse spacing of the spike holes would be the same in all designs, but even this dimension is subject to variation, although the range of variation is small.

Even Spike Holes Vary

Another feature of design which might be expected to be well-stabilized is the size of the spike hole since, normally, only two sizes of track spikes are used. Here again, however, variations are found, not only in the size but also in the shape of the holes. While the great majority of the holes are square, a number that are slightly oblong were noted in the two groups of plates. Square holes were found to range from 9/16 in. to 1 in. in dimension, with differences of 1/16 and 1/32 in. In some designs, more than one size of spike hole was noted. In the oblong holes, the small dimension ranged from 21/32 to ¾ in., and the long dimension from ¾ to 13/16 in.

When we come to consider combination punchings to permit individual designs of tie plates to be used with several sections or weights of rail, we encounter such a multitude of different arrangements and spacings of the spike holes that it is impossible to go into detail. These combinations are accomplished by punching several separate spike holes, by providing one or two long slotted holes on the gage side or by stepped punchings for two or more widths of rail base.

As a still further complication in the matter of tie plate punching, many roads are now using independent fastenings to secure the plate to the tie. For this purpose two, three or four additional holes are required, depending on the preference of the individual roads. In some cases, a single road is using two of these combinations. Some of the holes for the independent fastenings are round to accommodate screw spikes; others are square for cut spikes. While the designs for independently-fastened tie plates are fewer in number, variations are found in the arrangement and spacing of the spike holes similar to the punchings for the rail fastenings.

Not a few roads require that their tie plates be punched right and left. In some cases, they also reverse the stagger of the combination punchings in both the right and left plates. In the first instance, this is equivalent to two different punchings, and in the second, to four for the same design of plate.

These differences in design have been discussed in detail to show not only the multiplicity of designs for the tie plate itself, and the still greater multiplicity in the designs for the punchings, but the further fact that many of the designs differ so little, or the differences occur in such unimportant details, that these variations do not in any way affect the utility or life of the plate, or the life of the tie. For example, there would seem to be little difference in the value of a tie plate in which the radii forming the outer contour of the shoulder are ⅜ in. and 11/32 in. as compared with another plate in which these radii are 5/16 in. and 7/16 in., respectively.

It is obvious that the design of a tie plate for a 65 or 70-lb. rail should differ from one to be used with rails weighing 112 or 131 lb. Our next step, then, is to determine whether there are any advantages or disadvantages in a multiplicity of designs for rails having the same width of base.

New tie plates are seldom carried in stock in any considerable quantity, but they are generally ordered in the quantities required and are applied out of face with rail as it is laid, or to unplated ties during tie renewals. When rail is renewed, they are kept with the released rail and such plates as are suitable for further use are applied with it when it is relaid. Differences in design are, therefore, of no concern from this standpoint.

For these reasons, assuming that the several designs are capable of giving satisfactory service, there is no particular disadvantage in several designs, or in frequent change in design, for a particular section of rail. On the other hand, there is no apparent advantage to an individual road in changing its design unless some fundamental improvement is made, such as an increase in thickness or area, the addition of a shoulder to a single-shoulder plate, or the provision for independent fastenings. There may be a decided advantage, however, in having different designs of tie plates for heavy and light rail sections.

Our Next Step

Our next step is to determine whether there will be any advantage in the use of identical designs by two or more roads. Since the railways do not interchange materials of this character, it is of no importance to one road that another is using the same design of tie plate, so far as this affects its local maintenance problems. On the other hand, where the tonnage requirements of the roads involved are small, it may be easier for them to obtain rollings if they use a common section.

There are broader aspects to the question, however, than those of local interest, which have a definite influence on the cost of materials. To obtain a clear understanding of the broader question of economy, we must, as before, turn to the manufacturer to find how he is affected by a multiplicity of designs and how they react through him to the railways.

Every tie-plate section requires an independent set of rolls. A set of rolls for tie plates costs from $3,000 to $12,000, depending on the size of the mill, including the necessary spares which must be provided to insure against delay in case of breakage or other damage and for use while worn rolls are being dressed. The life of a set of rolls varies from 8,000 to 10,000 tons, and a roll requires dressing after every 1,000 tons of tie-plate bars produced.

There is this difference between rolls for producing tie plates and

those for rolling rails: Rolls for producing rails can never be used for any section other than that for which they are made. On the other hand, tie plate rolls are sometimes used in different combinations, since certain of the rolls in the set are dressed to form the top of the plate, while others are dressed for the bottom design. It is possible, therefore, to apply rolls for either plain, ribbed or corrugated bottoms with any design for the top of the plate.

Every design of top or bottom requires a different roll and, except where the bottoms are flat, the position of the shoulder on the top roll usually controls the location of the bottom pattern, so that the advantage of assembling different top and bottom rolls is nominal rather than real. Furthermore, every difference in the length of the plate makes an entire new set of both top and bottom rolls necessary. The result is that the mills find it necessary to provide both primary and duplicate sets of rolls for almost every design of tie plate, the number of these sets being multiplied by the number of mills to which the road using the design distributes its orders.

If an order for tie plates of any design is of sufficient magnitude to wear out a set of rolls, or if the section is used over a period that allows for complete amortization of the rolls within a reasonable time, it makes little difference to the manufacturer what the design is. Orders of this size are rare, however, since large orders are usually divided among several mills, while orders for as small a quantity as 300 tons are not uncommon. For these reasons, when rollings are completed, every mill involved is left with partly worn rolls on its hands which must be stored until a subsequent order is received.

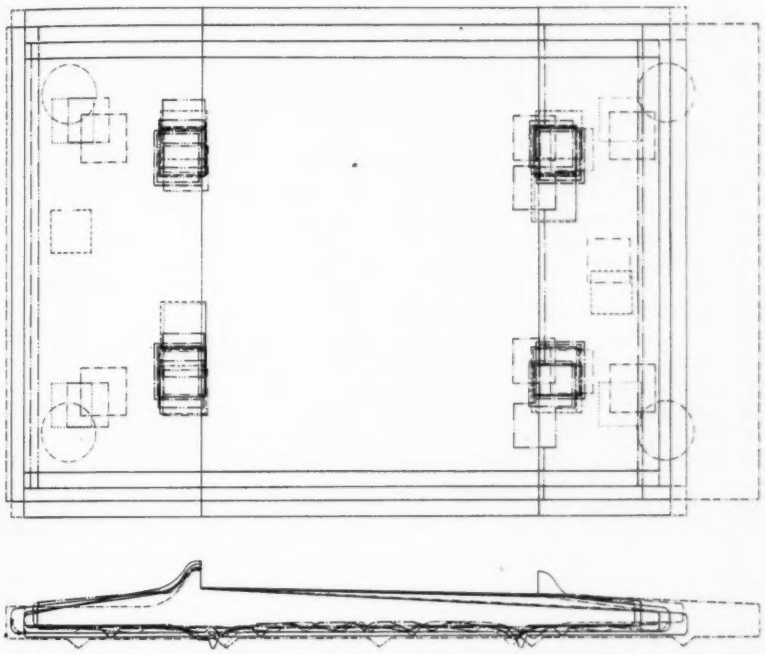
Frequent Changes

A further complication arises from the fact that not infrequently a road changes its design before the rolls can be amortized, sometimes after only a few hundred tons have been rolled. In such a case, the manufacturer has left on his hands a set of rolls which he cannot use and yet dares not discard, for experience has taught him that he may be called on at some future time to roll more plates of this design. More frequently, however, the rolls remain completely useless. For these reasons he must store the partly worn rolls and carry the depreciation and interest charges on the unamortized investment which they represent.

Another item of cost to the manufacturer, which in the aggregate represents a large sum, is the requirement of practically all roads that the year in which the rolling was done shall be shown on the tie plate in relatively large figures. Where only a small tonnage is required annually, the loss of metal on the rolls incident to the necessary dressing and cutting of the new date may be greater than the actual loss from wear. This is also true of other changes in lettering or numbering, among which is a common requirement that where a single design is used for two or more rail sections, the plates must bear a designation for the individual sections with which they are to be used.

As has been mentioned, certain roads require that their plates shall be made right and left. Where this requirement also includes a designation, such as the letters R and L, to permit quick identification of the plates, an additional roll is required for the second letter.

When the rolling of the tie plate bar is completed, it is by no means a finished product. It must be sheared to the proper width, punched to conform to the design and, in some instances, it must be given a camber. There are two methods of punching tie plates—hot and cold. Plates made of low-carbon steel containing 0.30 carbon or less can be sheared and punched cold, while if the carbon is above 0.30, these operations must be performed while the metal is hot.



Composite Drawing Showing Some of the Variations in 11 Tie Plates in Current Use

Elements of Cost

A set of dies, punches and punch holders for cold work costs from $50 to $200, depending on the size and thickness of the tie plate and the number and arrangement of the holes. Where combination punching is required, the cost is considerably higher, but is difficult to state since it depends on the form of the combination. It will be seen, therefore, that where a road demands five or six, or even more, punchings, the cost of the punching equipment may amount to more per ton than the amortized roll cost.

Where hot work is required, and this is necessary on very thick and heavy-shouldered plates as well as on those of high-carbon steel, it is necessary to reheat the tie-plate bars and to provide a new set of high-speed tool-steel punching dies, punches and shear plates. An entirely different set of feed rolls is also required. The punch holders for hot work cost the same as for cold work, but the cost of the remaining equipment is about doubled.

Another item of cost which a manufacturer cannot ignore is that of changing the dies in the machines for the different punchings. While the out-of-pocket cost of this operation is relatively small, ranging from $2.50 to $6, both the machines and the operators are idle during the change, the result being considerable loss of production, which is a direct charge on

the manufacturing operation. This item is, therefore, by no means negligible, and may be of considerable magnitude in an order that calls for 6 to 12 different punchings.

These facts indicate quite clearly that both a multiplicity of designs and frequent changes in design, with respect to punchings and sections of tie plates, place the manufacturer at a disadvantage and add an appreciable amount to his costs. For this reason, any reduction in the number of sections or punchings will result in a corresponding decrease in the cost of manufacture.

It is not debatable that any requirement that increases the manufacturer's costs increases the price which the railways must pay for his product, for in the last analysis prices are always based on cost. No manufacturer can long remain in business if he neglects to include all of his costs and pass them on to his customers.

As with other materials and devices which we have discussed in this series of articles, there are commercial reasons which make it impracticable for a manufacturer to assess against any individual road even the unreasonable costs to which that road may have subjected him. He must, therefore, spread these costs over his entire output and thus penalize every road alike, although some of them may have little or no part in adding to his production difficulties.

What of Standardization?

With these facts in mind, it is pertinent to inquire whether tie-plate design can be standardized. The present situation with respect to this device closely resembles that connected with rail design 50 or more years ago. While many engineers recognize that this situation is more or less anomalous, few of them are ready to admit that other designs are superior to their own. On the other hand, relatively few are completely satisfied with their own designs, and they are constantly striving to improve them, for which reason they are making frequent changes in these designs.

As a result, there has been no noticeable trend toward reducing the number of designs. In fact, it is probable that the total number of designs in current use today is greater than it was 20 or 25 years ago. Certain features of design, once popular, do not appear in modern tie plates, such as the corner claw and deep longitudinal ribs. There has been a general increase in thickness, width and length, and practically all present-day designs call for at least one shoulder. Recently, the double-shoulder type has been gaining favor, and an increasing number of roads are applying tie plates with independent fastenings.

These indications point to a certain amount of stabilization with respect to the major features of tie plate design. In the natural course of events it is to be expected that these trends will result in a marked reduction in the number of designs. On the other hand, since they are still in the development stage, they have, in themselves, initiated many of the differences which have been pointed out in the foregoing discussion.

Objections Raised

In considering whether the roads will be willing to accept rigid standards in the design of tie plates, we are confronted with the fact that few engineers are willing to contend that the last word has yet been said with respect to the designs of this device. It is also questionable whether a rigid standard can be developed which will meet the requirements of all of the roads. Manifestly, a road having a relatively light traffic does not need tie plates of the weight or dimensions that may be of vital importance to another with traffic of much greater density and higher speed. A tie plate that would be most economical on the latter might be grossly extravagant on the former. Yet, the fact that both roads need to use tie plates can be easily demonstrated.

While many railway engineers recognize that present conditions are wasteful and are undesirable in other ways, few of them are willing to surrender their freedom of action or restrict their opportunities to improve a device by adopting standards, particularly when they are not convinced that these standards represent an advance as compared with their own designs. If no other evidence of this attitude were available, the decisive rejection of the proposed standard designs of tie plates which were recently submitted to letter ballot by the American Railway Engineering Association would be sufficient confirmation.

Recognizing this attitude as a powerful factor militating against the adoption of rigid standards for tie plates, we are led to consider whether the present chaotic and wasteful conditions should be permitted to continue without restriction, or whether the number of designs can be reduced without detriment to the roads. It is obvious that improvements in design will be hampered if not completely halted by placing severe restrictions on major features of design, such as would occur under rigid standardization.

It is also equally obvious that many of the minor differences, particularly where they occur in non-essential details, can be compromised without detracting in any way from the usefulness or service characteristics of the tie plate. Action along this line would, in itself, materially reduce the present number of designs. It would also afford an excellent means of starting a trend toward still greater simplification in tie plate design.

It has been shown that at present there is unnecessary multiplicity of designs for tie plates and much needless waste in their manufacture, which react unfavorably on the railways. The question now arises whether standardization is necessary to eliminate this waste and reduce the manufacture of tie plates to a satisfactory economic basis. In other words, is there a limit in the number of designs beyond which there would be no further economy from standardization?

To answer this question we must ascertain how much of a reduction will be necessary to accomplish the desired objective, as well as how many designs will be needed to give ample opportunity for selection to meet the diverse requirements of the roads. There are relatively few basic differences in design, such as single and double shoulders; flat, ribbed and corrugated bottoms; straight and inclined ends; independent fastenings, etc. The remainder are largely variations on these fundamental forms. So far as the manufacturer is concerned, the most critical dimension is the distance from the shoulder to the outer end of the plate.

Marked Advantages

If the minor differences which now appear in such numbers in each basic design could be compromised for each width of rail base, and this should not be particularly difficult, the number of designs would be reduced to a comparative few, yet the roads would be able to select the design or designs best suited to their needs. On the other hand, the manufacturer would have no greater investment in rolls, and but little more in punching equipment, than would be required by rigid standardization. He would also be assured of quick amortization and relieved of the fear that useless equipment would be left on his hands. Simplification, or a reduction in the number of designs of tie plates, therefore, possesses all of the advantages of standardization, without its disadvantages.

What's the Answer?

Exploring Subsoil Conditions

Under what conditions are borings justified to obtain data on subsoil conditions in advance of the driving of piles? What other methods of exploration can be employed to advantage?

Test Piles Are Best Guide

By S. F. Grear

Assistant Engineer of Bridges, Illinois Central, Chicago

When exploring subsoil conditions, boring tests are valuable especially for determining whether piles are necessary, rather than as a means of determining the length of piles. When there is a possibility of rock or other hard material within the reach of piles, borings should always be made. However, if the hard material is sufficiently close to the surface to permit the foundation to be examined in its natural state by open excavation, this method should be used as a check on the borings.

When boring tests are being made, the study should be made on the basis of data obtained from a number of holes, as a boring tool may be stopped by a boulder, thus giving a wrong impression of the condition. Errors of this kind may, of course, be avoided by core drilling, but, except for deep work, this method is not ordinarily used.

Where piles are known to be necessary, the only real test involves the driving of test piles. Ordinarily such piles can be driven from the surface of the natural ground, but in certain cases, especially where the driving is hard, they should be driven from the bottom of an excavation.

Piles selected for testing work must be of a size that represents the average of the piles to be used and must be capable of withstanding the effects of hard driving. They must be driven to refusal, or at least well below the point where the proper bearing power is indicated.

After the test pile has reached a penetration of 10 ft., the number of hammer blows required for each foot of additional penetration should be counted in order to afford data on which to estimate the bearing power at any given depth. In addition to the number of blows per foot, a record must be made of the fall of gravity hammers and of the speed of double-acting steam hammers.

Borings Are Sure Method

By W. J. Savage

System Bridge Foreman, Missouri Pacific, St. Louis, Mo.

In my opinion borings are justified on all pile-driving work as the only certain method of determining the nature of supporting soils. In addition, data obtained from borings can also be used to eliminate guesswork in determining the length of piles needed.

One of the first questions to be answered prior to the construction of bridges requiring piling in the substructure concerns the length of the piling needed. At a time when wood piling is being replaced by reinforced concrete or steel piles, this problem becomes of added importance.

Information of a definite nature is essential in determining the correct length of concrete piling. If a pile trestle is to be replaced, we may resort to old records showing the penetration and resistance of piles at that location, or records may be available of concrete piles that have been driven in the same vicinity. At best, however, the use of such information involves considerable guess-work in coming to a decision.

Another source of information is the driving of test piles, but if we are replacing wood piles with 24-in. octagonal concrete piles which require heavy equipment in handling and driving, the cost of moving this equipment long distances merely to drive two or three test piles is prohibitive, to say nothing of the cost of the test piles themselves. The next best method is to drive a timber test pile with a steam hammer and, from the penetration and refusal records thus obtained, determine the length of the concrete pile required. However, this method also has its limitations. Where a large number of piles are to be driven, piles in several lengths can be driven at various locations at the bridge site where they will be part of the permanent structure, thus making it possible to determine accurately the length of piles required.

I have in mind a method which I believe can be developed to a point where it will be possible to determine with reasonable accuracy the length of piling for any given location. This method involves the use of data obtained by core drilling. With records at hand that show the depth of the various strata, an estimate is made

To Be Answered in April

1. *How should a French drain be constructed? What are its advantages? Its disadvantages? What maintenance does it require?*
2. *What is the best method of replacing a pipe culvert that has failed?*
3. *What precautions should be observed in the use of track wrenches to avoid injury to trackmen?*
4. *How can one determine whether a building or other structure is infested with termites?*
5. *When gage is widened on a curve, where should the widening start? Should the widening be done on the line or gage side? Why? How should it be tapered?*
6. *What methods can be employed to protect the floor system and bottom laterals of open-deck steel bridges from brine drippings?*
7. *Should the tie inspection for the next year's renewals be made in the spring or fall? Why? If the former, should the ties that are to come out be marked? How can this be done to distinguish them from this year's renewals?*
8. *What methods can be employed to lay a pipe line through swampy ground where the trench cannot be kept clear of water? What precautions must be observed? How can the line be tested for leaks?*

tear on the motor and engine bearings. They also have the disadvantage of being more noisy, although this can be overcome by the use of rawhide or fibre pinions. However, such gears wear rapidly, depending on the pitch-line speed, and the failure of a tooth in one of two meshing gears may cause teeth in both gears to break out, resulting in considerable delay unless extra gears are kept on hand. Furthermore, an emergency change in either the pump or the power unit would probably require the installation of new gears and a change in the entire set-up.

How Many Coats of Paint?

How many coats of paint should be applied to new wood surfaces? To old surfaces when repainting? Why? What difference, if any, should there be in the composition of each coat?

Should Use Three Coats

By Francis M. Hartley, Jr.
National Lead Company, New York

It is common practice to apply three coats in painting new wood. A paint film of three coats is exceedingly thin, being only about 1/200-in. thick in the thinnest place, while two coats are so thin that on weathering, the surface of the wood is exposed at an early date. Generally speaking, three coats of paint will last about twice as long as two coats.

The priming coat seals the surface and acts as a bond between the wood and the paint film. Our standard recommendation for this coat calls for 100 lb. of soft-paste white-lead in oil; 4 gal. of raw linseed oil; 1¾ gal. of turpentine and 1 pt. of drier. If the wood to be coated is rather hard and does not contain appreciable areas of soft wood, the linseed oil in this coat is sometimes reduced. However, this priming coat has produced excellent results, even when applied on rather hard woods.

The second or body coat of a paint film is so proportioned as to adhere well to the priming coat and to give a flat finish so that good adhesion will be provided for the third coat. Our standard recommendation for the second coat provides for 100 lb. of soft-paste white-lead in oil; 1½ lb. of raw linseed oil; 1¼ gal. of turpentine; and 1 pt. of drier. For the finish coat we recommend 100 lb. of soft-paste white-lead in oil; 3 gal. of raw linseed oil; and 1 pt. of turpentine.

When repainting, the old paint, if in good condition, acts as a priming coat and, therefore, only two additional coats are necessary. For the first coat in repainting, our standard recommendation is 100 lb. of soft-paste white-lead in oil; 2 gal. of raw linseed oil; 1¾ gal. of turpentine; and 1 pt. of drier. Slightly more linseed oil is used for this coat than for the second coat in new work. This additional oil is necessary to meet the requirements of the old paint film as to absorption. For the finish coat in repainting, the paint should be the same as for the finish coat when painting new wood.

No Primer on Old Surfaces

By H. M. Church
General Supervisor Bridges and Buildings, Chesapeake & Ohio, Richmond, Va.

When painting new wood surfaces, three coats, including the priming coat should be used. A small amount of turpentine should be mixed with the second coat, while the third coat does not need a thinner.

When the paint is in good condition on old structures that are to be repainted, a primer coat will not be required. In such cases two additional coats should be applied, adding a small amount of turpentine to the first coat where ready-mixed paints are used. As in painting new wood, the finish coat for old surfaces should have only the oil vehicle.

Vary with Species of Wood

By H. F. Cunniff
General Painter Foreman, Delaware & Hudson, Green Island, N. Y.

A good paint film may be obtained by the proper preparation of the surface, the use of high quality materials and the application of three coats to new wood—a thin priming coat and two heavier coats. It is important that the priming coat shall consist of the proper proportions of pigment and vehicle, depending upon the species of wood to be coated. A number of years ago it was considered good practice to use as a primer any paint, such as yellow ochre and linseed oil. However, these primers proved unsatisfactory, as subsequent checking and flaking of the paint required the expenditure of considerable sums for its removal.

Two coats are generally required for surfaces previously painted, for the old film acts as a primer if it is in good condition. It is not good practice to apply only two coats on new wood or one coat on previously painted surfaces. Although such applications may appear satisfactory at first, defects such as spotting and fading generally become prominent within a comparatively short period.

The consistency of priming coats for new wood should vary with the texture of the wood. For eastern spruce, white pine or redwood, linseed oil and turpentine should be used in the proportion of two to one. When priming other soft woods which are less absorbent, such as cedar, cypress and southern yellow pine, the proportion of turpentine should be increased.

The second coat for new lumber and the first coat for old painted surfaces should contain oil and turpentine in equal proportions. The third coat for new lumber, and the second coat for old painted surfaces should have six parts of oil to one part of turpentine.

Apply Thin Priming Coat

By E. C. Neville
Bridge and Building Master, Canadian National, Toronto, Ont.

Three coats of paint should always be applied to new wood because the dry wood absorbs so much of the oil in the first coat that there is not sufficient body left in the priming film to afford a good foundation for a finishing coat. For this reason, the priming coat should be of less density than the others, so that it will penetrate more readily into the wood and fill the pores, thus insuring that the second coat will not be robbed of oil.

The second, or body coat, should be slightly harder than the finishing film in order to prevent checking of the surface. To enable it to withstand atmospheric changes, the final coat should be made tough and elastic by the addition of slightly more oil.

When repainting old surfaces, it is good practice to apply two coats. The first should contain sufficient turpentine to soften the surface of the old paint so that a good bond will be obtained, while the finishing coat, as on new work, should be slightly more elastic than the one on which it is applied. In cases where the old paint has become badly checked, or is peeling in places, it should all be removed down to the wood and three coats applied as in new work.

If the various paint coats are not

properly proportioned, trouble is likely to develop with the paint film. The checking of the film is usually caused by the finish coat being harder than the under coat, owing to the use of an excess of oil in the latter. Running of the paint is due in most cases to the heavy application of a paint having an excess of oil.

Prime before Construction

By C. B. Woodruff

Draftsman, Engineering Advisory Committee, Van Sweringen Lines, Cleveland, Ohio

There are advantages in giving new lumber a priming coat before starting construction, the principal one of which is that it prevents checking or warping due to too rapid loss of moisture on one side of the piece. Air-seasoned lumber will retain about 20 per cent moisture and lumber erected on a hot day will lose a portion of this moisture content, the loss taking place most rapidly in the parts that are exposed to the sun. The priming coat may be mixed by adding enough white lead to linseed oil to give a white surface on which pencil marks may be drawn.

When painting a new structure, two coats in addition to the priming coat should provide a tough film and offer excellent protection. The finish coat may contain more pigment than the others, since the oil penetration will not be sufficient to deprive the pigment of support.

Standard Guard Rail Gage

What is the maximum variation from standard guard rail gage that is permissible? Why?

Maximum Is Indeterminable

By O. F. Harting

Assistant Chief Engineer, Terminal Railroad Association of St. Louis

Standard guard rail gage is now technically known as "guard check gage" and may be defined as "the distance between the guard line and the gage line, measured across the track at right angles to the gage lines." The standard dimension for this gage, as given by the A.R.E.A., is 4 ft. 6⅝ in., with a permissible minimum of 4 ft. 6½ in. A gage less than this minimum will permit wheels to strike the frog point.

The permissible maximum is indeterminable because, when the standard guard check gage is exceeded, other track dimensions come into the problem. For instance the standard may be somewhat exceeded, provided the distance between the two guard faces is not more than 4 ft. 5 in. but if the distance between these faces is greater than this, an infringement between the track structure and the equipment will result.

Permits ⅛ In. Each Way

By H. E. Herington

Section Foreman, Minneapolis & St. Louis, Jordan, Minn.

Standard guard rail gage, which is the distance between the gage line of the frog and the flange side of the guard rail, is 4 ft. 6⅝ in. In my opinion, a permissible variation of no more than ⅛ in. either way from the standard should be allowed, and this only because it is impossible to maintain the gage exactly to standard.

Because of the unequal creeping of the rails, the guard rail gage has a tendency to tighten rather than to increase and for this reason, it is more desirable that the gage be ⅛ in. greater than standard. If the gage is less than 4 ft. 6½ in. the wheels of equipment may mount the frog points, while if it is larger than 4 ft. 6¾ in. the proper adjustment of the guard rail will be disturbed.

Loose Bolts Affect Gage

By F. J. Bishop

Engineer Maintenance of Way, Toledo Terminal, Toledo, Ohio

We endeavor to maintain the gage on our guard rails within ¼ in. of standard, except where the flangeway is widened to accommodate the widened gage of the track on sharp turnout curves. It has been our experience that if the guard rail gage is allowed to become less than standard the point of the frog soon becomes damaged. We have also sometimes found that, even though the variation in the gage may measure ¼ in. or less, it actually becomes more under traffic because of the effect of loose guard rail bolts and worn blocks on the gage measurements.

Should Never Exceed ¼ In.

By Robert White

Grand Trunk Western, Drayton Plains, Mich.

Variations from guard rail gage should never be in excess of ¼ in. and, if possible, the gage should not be allowed to vary even to this extent. Where the guard rail gage is less than standard, pressure is exerted on the point of the frog, and where it is more than standard there is a tendency for the guard rail to become worn and also for the equipment to climb the wing rails. From long experience and observation I am convinced that many derailments at switches, especially in yards, that have been attributed to other causes, were in reality brought about by improper guard rail gage.

What Size of Ballast?

What is the most satisfactory range of sizes for stone ballast? For slag? For washed gravel? Do the character or density of traffic, or other conditions influence this range?

Two Factors Most Important

By A. L. Bartlett

Engineer Maintenance of Way, New York, New Haven & Hartford

Of the many factors which govern the range of sizes of stone ballast, two stand out as being particularly important. As the maximum size in the ballast increases, so do difficulties in surfacing, except where a general raise is being made, owing to the extra effort required to force large pieces of stone under the ties. On the other hand, a reduction in the minimum size introduces the possibility of increasing the percentage of still smaller stone, chips and dust.

With these facts in mind, the ideal stone will have a maximum size small enough to permit free working under the ties and a minimum size sufficiently large to exclude chips and dust. Character and density of traffic apparently have no bearing on the size of stone ballast to be used.

Experiments carried out during the last five years, in which 1-in. and ¾-in. stone were used for the full ballast section or as a base for standard ballast in wet cuts and in territory having a soft or clay subgrade, have

indicated that many of our arguments with respect to grades in stone ballast are based largely on theory rather than fact. We have found that there is no practical difference in the expense of maintenance or performance of track ballasted with 1-in. or ¾-in. stone, as compared with standard ballast. Such ballast will not require cleaning so often, as cinders do not penetrate appreciably below the surface, nor does the soft subgrade work upward into the ballast; thus puddled joints are practically eliminated.

Cites Numerous Factors

By J. B. Martin

General Inspector of Track, New York Central, Cleveland, Ohio

Stone ballast is used largely on heavy-traffic and multiple-track lines where a fairly consistent program of raising the track out-of-face is followed. In such locations, stone of such a size that it will pass a 2½ in. ring in any direction and be retained on a 1-in. screen, affords a well-sized ballast, providing it is free from dust, dirt and rubbish.

It should be specified, however, that the stone in each car of ballast shall range in fair uniformity between the limits mentioned. This is important, as it is frequently the tendency to load a car with a preponderance of either large or small sizes, thus producing a poorly balanced mixture.

On single-track lines and where traffic is not so heavy, it is probably desirable to use ballast in which the fragments are somewhat smaller than those specified, as on such lines the surface is ordinarily maintained by spot work with light raises.

The sizes given here also apply to crushed slag. With washed gravel, it is important to avoid a large number of round particles as these have a tendency to disturb the alinement. In addition, sufficient fine particles must be present to serve as a binder.

Conditions Vary Widely

By A. D. Kennedy

Assistant Engineer, Atchison, Topeka & Santa Fe, Chicago

The most satisfactory range of sizes for ballast materials depends on conditions that not only vary on a given railroad or territory, but even on adjacent stretches of track. It is impractical, therefore, to prescribe the proper or satisfactory range of sizes for universal use. It is reasonable to assume, all other things being equal, that the "satisfactory" range of sizes for stone ballast depends largely on the resistance of the stone to abrasion and weathering. However, the nature of the materials in the sub-ballast and subgrade influences the proper size as well as the kind of ballast, and, further, the term "satisfactory" involves the economic and availability features.

The character and density of traffic govern the sizes of fragments, according to the extent to which the latter influence the riding qualities of the track. Slight surface imperfections are more readily adjusted with the smaller sizes of stone. However, better drainage will be obtained with the larger sizes.

A stone-ballast section for an average railroad, assuming a firm subgrade, with a density of traffic of approximately fifteen million gross tons a year, should have at least from 6 to 8 in. of gravel or other suitable material as sub-ballast; then 10 in. of suitable stone, the size of which should range from 1¼ in. to 2¾ in., and, on top of this, 4 to 6 in. of stone, the size of which should range from ½ in. to 1 in. The ratio of the various sizes within the above ranges should be such that 95 per cent of the stone passes through screens to accommodate the larger sizes, 40-75 per cent through the intermediate screens and 0-5 per cent through the smallest size.

Precious-metal or non-ferrous slag produced in the southwest, because of its high resistance to abrasion and weathering, makes excellent ballast. This slag weighs more than 3,000 lb. per cu. yd. and for ballast purposes is broken up into fragments ranging in size from ½ in. to about 2 in., or slightly smaller than the sizes of crushed stone in general use.

Because of the multiple factors involved, I believe the decision as to the proper sizes of the fragments for all prepared ballast should rest with one familiar with conditions peculiar to the individual location.

Cambered Tie Plates

Should tie plates be cambered? Why? Are there any disadvantages?

Favors Crowned Tie Plates

By H. R. Clarke

Engineer Maintenance of Way, Chicago, Burlington & Quincy, Chicago

The use of cambered or crowned tie plates has increased greatly in the past few years and this would indicate that it is believed that the advantages outweigh the disadvantages. The disadvantage most frequently mentioned is that the cambered or crowned plate gives the rail base a line bearing on the tie plate. Theoretically, this is true, but as the camber used is slight the bearing of the rail base on the plate under load is such that the rail is not overstressed.

An advantage of cambered tie plates is that the slightly curved rail-bearing surface conforms more nearly to the wave motion of the rail under traffic than does an un-cambered plate and does not, therefore, result in the contact of the rail base being concentrated at the edge of the tie plate as the load approaches and leaves the tie. Moreover, the plate is not "rocked" by the wave motion in the rail, but lies more nearly immobile on the tie. This results in less action on the tie and improves the riding qualities of the track.

Cambered and crowned tie plates react similarly so far as the factors mentioned are concerned. However, the bottom of the cambered plate is curved while that of the crowned plate is flat. The later, therefore, will provide a better initial tie contact than the former and, perhaps, is to be preferred for this reason.

It is important with any type of tie plate that the bearing surface for the rail shall not be concave across the rail base, as this results in the load being carried on the outside edges of the rail base and sets up strains that may result in rail failure.

Cambered Plates Essential

By H. S. Clarke

Engineer Maintenance of Way, Delaware & Hudson, Albany, N. Y.

It is essential, in my opinion, to use cambered tie plates, particularly where they are fastened to the ties independently of the rail fastening. Where the tie plates are not cambered, the ties are shocked and rocked by each passing wheel, resulting in damage to the entire track structure and increased maintenance costs.

Doctor A. N. Talbot, in a recent discussion of the design of tie plates, said: "Without having heard the advantages claimed for a cambered plate, I should prefer the flat plate, especially if the ties are properly

adzed to the same plane for both rails." In Dr. Talbot's judgment the principle reason for providing a camber is to relieve small inaccuracies in the surfaces of the ties, due to adzing or tamping, that would have a tendency to place the tie plate at an angle with the plane of the base of the rail. His argument is that a cambered tie plate is subject to unusual stresses so that the average thickness would have to be greater than for a plate that is not cambered.

We have not encountered any trouble from this cause with tie plates for either 90-lb. or 130-lb. rail, although heavy plates are employed with each of these weights of rail.

Building Turntable Foundations

How can a turntable foundation be constructed under traffic?

Developed Unusual Method

By C. P. Disney
Bridge Engineer, Canadian National, Toronto, Ont.

On the Canadian National we have developed a rather unusual method for renewing turntable foundations under traffic, which involves the use of a precast concrete center that can be dropped into place in minimum time. While the new circle wall is being constructed, the new center pier is precast along one side of the pit where it can be picked up by a wrecking crane and set into position, two lifting stirrups being cast into the blocks for this purpose.

The procedure for installing the new foundation involves first the driving of sheet piling around the center pier and the installation of top horizontal bracing. The material around the center pier is then excavated to rock, if it is near the surface, the rock being drilled so that it can be blasted to the proper depth later. The turntable and the old concrete center pier are then lifted out bodily by means of a wrecking crane operating from a temporary trestle or crib structure.

The next operation is to excavate to rock inside of the sheet piling and to blast the rock where necessary to attain the required depth. The excavation is then back-filled with rock, using coarse rock at the bottom and smaller material as the top is approached, thoroughly tamping each two-inch layer of stone with a pile hammer, using a rammer block.

After the rock back-fill is brought to the proper level, the new center pier is set in place with the crane. If the top of the pier does not come to the proper elevation and is not perfectly level, the block is raised and the rock back-fill adjusted accordingly, this operation being repeated until the pier is perfectly level. A variation of this method was employed in the installation of a center pier at Monk, Que., where the precast center pier was set in place on a pile foundation, the piles having been cut off to an exact level.

Preparation Reduces Time

By Division Engineer

Few problems have been more difficult of solution or taxed to a greater extent the ingenuity of maintenance officers than that of renewing a turntable foundation at a busy enginehouse. The reason for this is that interference with the operation of the enginehouse must be reduced to the minimum to avoid inconvenience in the handling of the motive power and probable delays to trains.

Some time ago we replaced an old and relatively light turntable at a very busy enginehouse with a longer and considerably deeper one. As the old foundation was constructed of stone masonry, it was necessary to remove it and deepen the foundation excavation about five or six feet. In preparation for this, we drove sheet piling flush with the outer perimeter of the new footing and excavated around the old foundation to the bottom of its footing. In the meantime, a new circle wall had been built and the old circle removed. At the same time, a reinforced concrete foundation block was constructed at a convenient point for lifting into the pit.

As soon as the old turntable was out of service it was lifted out of the pit, the old stone foundation was removed and the excavation completed by means of a clamshell. While this excavation was under way, a trestle was set up with bents that had been framed beforehand, this being for the purpose of bringing in the foundation block. Two mixers had been set up at convenient points for producing the concrete necessary for the new footing and this was all mixed and ready for placing a few minutes before the excavation was completed. The buckets containing the mixed concrete were then dumped into the excavation, tamped into place and carefully finished to an elevation ½ in. higher than the final elevation.

While these operations were under way, an 85-ton wrecking derrick had brought the 52-ton foundation block to the edge of the pit. As soon as the footing was finished, without waiting for the concrete to harden, this block was placed. The immediate settlement was all that we had to contend with, this being 5/8 in. on one corner and 19/32 in. at the corner diagonally opposite. This difference was easily cared for, however, by means of shims which we had prepared in advance. The table was then placed and locomotives were allowed to pass over it as soon as it was adjusted.

Supported on Needle Beams

By F. A. Howard
Engineer of Structures, Erie, Cleveland

Many turntable installations have been rebuilt during my connection with the Erie. In most of these cases the turntable for the new installation was longer than the one removed, requiring new circle walls back of the old ones, while the center foundations usually were lowered and provided with larger bases. The construction of the new circle wall does not present any special difficulties, but the reconstruction of the center foundation, if on the same site as the old one, is more of a problem.

In one instance the turntable was maintained in service during the construction of the foundation by supporting it on needle beams which were installed on pile bents under the turntable center after the old foundation had been cut away, the pile bents being located outside of the limits of the new foundation. The needle beams were so arranged that their top surfaces were even with the top of the new foundation. The remainder of the old foundation was then removed and the new foundation constructed, the needle beams being embedded in the new concrete. After the concrete had cured sufficiently, the projecting portions of the needle beams were cut off, the remainder being allowed to remain in the concrete to serve as a grillage under the new center.

In a more recent installation, the new circle wall was constructed and the turntable was then taken out of service while the old center foundation was replaced. By using a quick-setting cement the period during which the table was out of service was reduced to the minimum. In this instance a wye was available on which to turn the locomotives.

News of the Month . . .

Expect Small Increase in Freight Car Loadings

Freight car loadings in the first quarter of 1935 are expected to be about 0.6 per cent above actual loadings in the same quarter in 1934, according to estimates compiled by the thirteen shippers' regional advisory boards. On the basis of these estimates, car loadings of the 29 principal commodities will be about 4,528,700 cars in the first quarter of this year, as compared with actual loadings of 4,500,200 cars of the same commodities in the corresponding period of 1934.

Six of the advisory boards anticipate that carloadings in their districts will increase in the first quarter, while the other seven expect decreases. The largest increase, 12.8 per cent, is expected to take place in the Great Lakes region, while the greatest decrease, 14.3 per cent, is anticipated for the Northwest region. Of the 29 commodities covered in the forecast, it is estimated that the loadings of 19 will increase while those of 10 will decrease.

F. E. Williamson Optimistic About Future

Frederick E. Williamson, president of the New York Central, in a recent address at Buffalo, N.Y., declared that "at no time within the experience of my hearers have the railroads been more alert to their responsibilities and, likewise, to their opportunities." Mr. Williamson discussed the importance of the carriers to the prosperity of the local communities which they serve; refuted the charge that railroads as a whole are over-capitalized; stressed the need for the equitable regulation of all carriers; and condemned the St. Lawrence waterway as a project which would "add measurably to the tax burden and this at a time when it is rapidly becoming unbearable." In a discussion of "pleasanter topics" Mr. Williamson explained how the depression has been a spur to progress and to railway enterprise, listing in the latter connection developments such as light weight equipment and streamlined trains and locomotives.

Net Railway Income Down for Eleven Months

For the first eleven months of 1934 the Class I railroads of the United States had net railway operating income of $423,117,530, which was at the annual rate of return of 1.72 on their property investment, as compared with $436,485,963, or 1.77 per cent, in the first eleven months of 1933. Operating revenues for the eleven months totaled $3,013,940,715, as compared with $2,850,273,772 for the same period in 1933, an increase of 5.7 per cent. Operating expenses amounted to $2,246,421,068, as against $2,062,437,196, an increase of 8.9 per cent.

For November the Class I railroads had a net railway operating income of $31,582,703, or 1.47 per cent, as compared with $37,662,122, or 1.74 per cent, in the corresponding month of 1933, a decrease of 16.1 per cent. Operating revenues amounted to $256,967,180, as compared with $257,685,946, a decrease of 0.3 per cent. Operating expenses totaled $197,871,881, as against $191,841,964, an increase of 3.1 per cent over November, 1933.

Milwaukee Plans Streamlined Steam Service

Plans are now being perfected by the Chicago, Milwaukee, St. Paul & Pacific, for the inauguration of high speed streamlined trains in service between Chicago and the Twin Cities early in the spring, which will involve the use of streamlined oil-burning steam locomotives and streamlined roller-bearing coaches. The new locomotives, two of which are now under construction by the American Locomotive Company, will embody a number of entirely new features and were specially designed for sustained high speed service. They will be the first streamlined steam locomotives to be newly built throughout. The coaches, which are being constructed in the railroad's shops, will be air conditioned and the rear cars in the trains will have their rear ends rounded in accordance with streamlining practice. The new trains, schedules for which have not yet been established, will carry a cafe car and a parlor car in addition to the day coaches.

Railroads Order Rails

Since the first of the year the market for rails and fastenings has become active and a number of railroads have placed orders for their 1935 requirements, while still others are preparing to enter the market. The largest order for rail placed so far this year is that of the Norfolk & Western for 32,000 tons of 131-lb. rail, 24,000 tons of which have been ordered from the Carnegie Steel Company and 8,000 tons from the Bethlehem Steel Company. The Louisville & Nashville has ordered 15,000 tons of rails from the Tennessee Coal, Iron & Railroad Company, while the Delaware, Lackawanna & Western has placed an order for 4,000 tons of rails and 3,000 tons of rail fastenings. The Southern Pacific is expected soon to enter the market for 26,740 tons of rails, and the Chicago, Burlington & Quincy is planning to buy 15,000 tons of rails and 4,000 tons of track accessories. The New York Central expects to purchase 20,000 tons of rails and 9,000 tons of fastenings with an additional allotment of $1,206,000 which it recently obtained from the Public Works Administration.

Railway Purchases Show Increase for 1934

Railway purchases in 1934, exclusive of new equipment, amounted to approximately $625,000,000, an increase of $160,000,000, or 35 per cent, as compared with 1933, according to figures based on the purchases for the first 10 months of the year. On the basis of these figures, railway purchases last year increased $180,000,000 over 1932, although they were $70,000,000, or 6 per cent, less than in 1931. In 1934 the railroads expended approximately $39,000,000 for crossties, an increase of 100 per cent, as compared with 1933; $32,000,000 for rail, an increase of 200 per cent; $211,000,000 for locomotive fuel, an increase of 18 per cent; and $340,000,000 for miscellaneous materials, a 50 per cent increase as compared with 1933.

Travel to Florida and California Increases

Railway passenger traffic to Florida and California is showing a large increase this season as compared with a year ago. The increase in travel to Florida has been especially large, the movement having started in larger volume and at an earlier date than heretofore and promising to continue throughout the season. The heaviest movement has been experienced in the eastern territory where the business of three roads showed an increase of 40 per cent during November and December, as compared with last year. Travel between Chicago and Florida during the same period increased 20 to 25 per cent over last year and reports indicate that the increase was sustained throughout January. Winter travel to California has also shown an increase this year.

Transport Regulation Planned by Administration

Transportation legislation along lines that have been advocated by the railroads for years was mentioned specifically as being a phase of the legislative program of the Seventy-Fourth Congress, in the address of President Roosevelt before a joint session of the Senate and House of Representatives on January 4. Only part of one sentence in the report, however, was devoted to this subject, as the President expects to prepare a special message concerning this matter for transmission to Congress at a later date. "Among the subjects that lie immediately before us," the President said, "are the consolidation of federal regulatory administration over all forms of transportation. . . ." It is understood that this statement envisages the extension of federal regulation to certain carriers to which very little has thus far been applied, such as highway motor vehicles operating in interstate commerce and the carriers operating on inland waterways and in coastwise and intercoastal service.

Association News

Railway Tie Association

The Railway Tie Association will hold its seventeenth annual convention at St. Louis, Mo., on May 15-17.

International Railway Maintenance Club

The first meeting in 1935 of the International Railway Maintenance Club will be held at the Statler Hotel, Buffalo, N.Y., on February 14. The meeting will take place in the afternoon, immediately following luncheon, which will be served at 12:30. The principal speaker at the meeting will be R. W. E. Bowler, engineer maintenance of way of the Pennsylvania with headquarters at Buffalo, N.Y.

Maintenance of Way Club of Chicago

Safety in Maintenance of Way Work was the subject of an address by H. C. Murphy, superintendent of safety, Burlington System, at a meeting of the club on Wednesday evening, January 23, at which 43 members and guests were present. The next meeting will be held on February 20, when C. R. Knowles, superintendent of water supply and work equipment of the Illinois Central, will present a paper on Off-Track Work Equipment.

Metropolitan Track Supervisors' Club

The next meeting of the Metropolitan Track Supervisors' Club will be held at the Hotel McAlpin, New York City, on Thursday, February 21, following dinner at 6:30 p.m. The dinner has been arranged as a matter of convenience, and attendance is not necessary to attendance at the meeting proper, which will begin at 8 p.m.. The principal speaker at the meeting will be J. E. Long, superintendent of safety of the Delaware & Hudson, at Albany, N.Y. A meeting of the officers of the club will be held immediately prior to the dinner hour.

Wood-Preservers Association

The thirty-first annual convention was held in New York on January 22-24, with 185 members and 79 guests present. Reports and papers of interest to railway engineering and maintenance officers are abstracted elsewhere in this issue.

At the concluding session, officers were elected as follows: President, Frank D. Mattos, manager treating plants, S.P., West Oakland, Cal.; first vice-president, R. S. Manley, president, Texas Creosoting Co., Orange, Tex.; second vice-president, F. C. Shepherd, consulting engineer, B. & M., Boston, Mass.; treasurer, H. L. Dawson, re-elected; members executive committee, B. M. Winegar, Canada Creosoting Co., Montreal, Que.; W. R. Goodwin, engineer wood preservation, M.St.P. & S.S. M., Minneapolis, Minn. Memphis, Tenn., was selected as the convention city for 1936.

At a meeting of the executive committee held immediately following the conclusion of the convention, chairman of committees were re-appointed for the following year as follows: Preservatives, R. E. Waterman, chemist, Bell Telephone Laboratory, New York; Treatment of Car Lumber, H. R. Duncan, superintendent timber preservation, C.B. & Q., Galesburg, Ill.; Poles, Pressure Treatment, R. H. Colley, engineer, Bell Telephone Laboratories, Inc., New York; Poles, Non-Pressure Treatments, J. D. Burnes, engineer wood preservation, Page & Hill Co., St. Paul, Minn.; Tie Service Records, W. R. Goodwin, engineer wood preservation, M.St.P. & S.S.M., Minneapolis, Minn.; Bridge and Structural Timbers, T. H. Strate, division engineer, C.M.St.P. & P., Chicago; Marine Piling Service Records, M. F. Jaeger, superintendent, Port Reading creosoting plant, Reading-C.R.R. of N.J., Port Reading, N. J.; Pole Service Records, H. A. Haenseler, engineering department, Western Union Telegraph Co., New York; Diversified Uses of Treated Wood, E. P. Gowing, assistant to vice-president, American Creosoting Co., Louisville, Ky.; Processing of Wood, A. W. Armstrong, president, Wood Preserving Corp., Pittsburgh, Pa.; Effect of Treatment on the Inflammability of Wood, George E. Hermann, vice-president, Canada Creosoting Co., Vancouver, B.C.; Revision of Treating Specifications, R. S. Belcher, manager treating plants, A.T. & S.F., Topeka, Kan. In addition, a committee on Post Service Records was re-established, the chairman for which will be announced shortly.

At this meeting, H. L. Dawson was re-appointed secretary of the association for the year.

American Railway Engineering Association

The following members of the American Railway Engineering Association have been nominated as officers for the year beginning at the close of the next annual convention on March 14: President, Robert H. Hord, assistant chief engineer, C.R.I. & P.; second vice-president, J. C. Irwin, valuation engineer, Boston & Albany, secretary, E. H. Fritch; treasurer, A. F. Blaess, chief engineer, I.C.

Directors (three to be elected): C. B. Stanton, professor of civil engineering, Carnegie Institute of Technology; W. T. Dorrance, assistant to chief engineer, N.Y., N. H. & H.; D. J. Kerr, assistant to vice-president, G.N.; W. C. Barrett, operating department, L.V.; Bernard Blum, chief engineer, N.P.; F. R. Layng, chief engineer, B. & L.E.; Meyer Hirschthal, concrete engineer, D.L. & W.; W. H. Penfield, engineer maintenance of way, C.M.ST.P. & P.; Ralph Budd, president, C.B. & Q.

Members of Nominating committee (five to be elected): M. M. Backus, assistant engineer maintenance of way, I.C.; E. G. Hewson, engineer maintenance of way, C. N.; J. G. Brennan, engineer of grade crossings, N.Y.C.; M. J. J. Harrison, general scale inspector, Penna.; C. J. Geyer, engineer maintenance of way, C. & O.; Robert Faries, assistant chief engineer-maintenance Penna.; F. S. Hewes, office engineer, A.T. & S.F.; F. S. Schwinn, assistant chief engineer, M. P.; H. Austill, bridge engineer, M. & O.; J. S. Lillie, property and tax commissioner, G.T.W.

In addition to the above, A. R. Wilson, second vice-president of the association automatically becomes first vice-president.

Secretary E. H. Fritch and the members of his staff are now engaged in completing the publication of the committee reports, all of which are in their hands. Bulletin 372 containing the reports of six committees will reach members early in February, to be followed shortly by Bulletin 373 containing six additional reports. The last bulletin to reach the members will be 374, which is to embrace the reports of the Committees on Wooden Bridges and Trestles, Iron and Steel Structures, Masonry, and Standardization; and as the first three of these reports are more voluminous than ordinarily, the last bulletin will be the largest.

In a letter from Secretary Fritch to the chairmen and vice-chairmen of all standing committees, notice is given of the decision of the Committee on Outline of Work to issue no new instructions to the committees in January as has been done for a number of years past. In lieu of this, the committees are instructed to continue their work on present assignments and with present personnel until a new report of the Committee on Personnel and Outline of Work is issued shortly after the annual convention.

Only one committee held a meeting during the month of January, namely, the Committee on Yards and Terminals, which met at Buffalo on January 15. The Committee on Iron and Steel Structures will hold an organization meeting at Columbus, Ohio on February 7.

The subcommittee of the Committee on Rail, which is engaged in a study of long rails, has received an enormous amount of data on experience with long stretches of continuous rail from various railways in Europe, in reply to a questionnaire issued by the committee some months ago.

Bridge and Building Association

Plans are being made for the executive committee to meet in Chicago on Wednesday, March 13, during the convention of the A.R.E.A.

President Benjamin has prepared a booklet on the advantages of membership which will form the basis for a campaign for new members.

The editing of the proceedings is now approaching completion and the manuscript will be turned over to the printer within the next month.

Letters were sent to members on November 26 calling for volunteers to serve on committees studying subjects in which they were especially interested. More than 60 returns were received, which formed the basis for the committee organization which has been appointed as follows:

Committee No. 1—To report on the Use of Treated Timber in Buildings: L. C. Winkelhaus, Archt., C. & N.W. (Chairman); E. A. Harrison, Archt., A.T. & S.F.; A. O. Lagerstrom, Archt., C.M.St.P. & P.; E. L. Rankin, Archt., G.C. & S.F.;

Thos. D. McMahon, Archt., G.N.; J. E. Cooper, B. & B. Fore., S. P. (Pac. Sys.); A. T. Hawk, Engr. Bldgs., C.R.I. & P.; H. H. Ueckert, Supvr. Struct., S P (Tex. & La. Lines); M. A. Berringer, B. & B. Fore., I.C.; W. G. Kemmerer, Asst. Engr., Penna.; W. G. Swartz, Engr. Acct., C.N.

Committee No. 2—To report on the Cleaning of Steel Bridges Preparatory to Repainting: E. C. Neville, B. & B. Master, C.N. (Chairman); H. Cunniff, Gen. Fore. Painter, D. & H.; J. J. Wishart, Supvr. B. & B., N.Y., N.H. & H.; W. A. Stewart, Asst. Supvr. B. & B., Cen. Vt.; W. A. Hutcheson, Asst. Supvr. B. & B., C. & O.; C. L. Metzmaker, Supvr. B. & B., C. & I.M.; J. P. Yates, Supvr. B. & B., G.C. Lines; C. N. Billings, Supvr. B. & B., S.P. (Tex. and La. Lines); A. Sweet, Fore. B. & B., A.T. & S.F.; G. L. Sitton, Ch. Engr. M.W. & S., Sou.; E. Patenande, B. & B. Master, C.P.; L. G. Byrd, Supvr. B. & B., M.P.

Committee No 3—To report on the Inspection of Bridges and Buildings in the Light of Today's Deferred Maintenance: D. T. Rintoul, Syst. Bridge Insp., S.P. (Chairman); J. G. Sheldrick, Engr. M.W., Soo Line; Armstrong Chinn, Ch. Engr, Alton; W. E. Carnes, Asst. Div. Engr., N.Y.C.; F. A. Armstrong, Supvr. B. & B., S.P. (Pac. Sys); T. P. Soule, Gen. Supvr. B. B., N.Y.C.; H Toms, B. & B. Master, C.N.

Committee No. 4—To report on the Welding of Pipes in Water Supply, Plumbing, etc.: C. M. Burpee, Res. Engr., D. & H. (Chairman); W. H. Harrison, B. & B. Mast., C.P.; R. C. Henderson, Mast. Carp., B. & O.; W. E. Pierce, supvi. wat. serv., D. & H.; Thos. E. O'Brien, B. & B. Master, D. & H.; C. R. McIlhenny, Rdm., T.C. & I.; Wm. S. Rich, Gen. Fore., N.Y.C.; W. A. Batey., Sys. Br. Insp., U.P.

Committee No. 5—To report on Types of Floors for Highway Bridges Under Various Service Conditions with Relation to Durability, Character of Sub-Floor Required, Cost and Surface Characteristics: J. J. Davis, Supvr. of Track, E.J. & E., (Chairman); J. H. McClure, B. & B. Master, C.N.; C. E. Herrom, Supr. B. & B., Alton; E. E. R. Tratman, Cons. Eng.; A. C. Irwin, Mgr. Sys. Bureau Portland Cement Assn.; C. W. Heritage, Bridge Engr.; K.C.S.; O. F. Howland, Constr. Eng., D. & H.; J. S. Hancock, Engr. Design, D.T. & I.; C. F. Weir, Supvr. B. & B., Pere Marquette; S. T. Corey, Asst. Bridge Engr., C.R.I. & P.; F. C. Brackett, Supvr. B. & B., B. & M.; T. W. Pinard, Engr. B. & B.. Penna.

Committee No. 6—To report on Relative Merits of Different Types of Pumping Equipment and Conditions Under Which Each is Most Suitable: C. R. Knowles, Supt. Wat. Serv., I.C. (Chairman); W. S. Lacher, managing editor, Ry. Engr. & Mtce. (vice-chairman); J. H. Bugg, supr. water serv., C.N.; T. B. Turnbull, supt. B. & B., Ann Arbor; W. E. Pierce, supr. wat. serv., D. & H.; F. H. Masters, asst. ch. engr., E.J. & E.; John P. Woods, supvr. B. & B., P.M.

Committee No. 7—To report on Under-Water Inspection and Examination of Railroad Structures: W. Russell Ganser, Mast. Carp. P.R. Seashore Lines (Chairman); E. C. Neville, B. & B. Master, C.N.; A. B. Scowden, Gen. Bridge Insp., B. & O.; H. A. Gerst, Asst. Bridge Engr., G.N.; J. S. Lowe, Supvr. B. & B., N.Y.N.H. & H.; C. A. J. Richards, Mast. Carp., Penna.; J. F. Lockwood, Supr. Bridge Erect., C. & O.; John E. Bird, Asst. Supvr. B. & B., N.Y.C.; W. C. Harman, Supvr. B. & B., S.P.; H. C. Jones, Bridge Insp., S.P.; J. F. Inabinet, Mast. Carp., S.A.L.; N. D. Howard, East. Engr. Editor, Ry. Engr. & Mtce.; E. R. Tattershall, Supvr. Struct., N.Y.C.

Roadmasters Association

Member of the executive committee met in Chicago on January 14, with C. W. Baldridge, president, J. J. Desmond and Armstrong Chinn, vice-presidents, James Sweeney, treasurer, P. J. McAndrews and J. J. Davis, members executive committee, Elmer T. Howson, past president, and D. J. Higgins, secretary, Track Supply Association, in attendance. The report of the Committee on Hotel Arrangements was received and the Hotel Stevens, Chicago, selected as headquarters for the 1935 convention. A contract was authorized for the printing of the proceedings of the 1934 convention, manuscript for which will go to the printer within a couple weeks. Committees were appointed to report at the next convention on the following subjects:

Committee No. 1—Recent Developments in the Organization of Track Forces: W. C. Pruett, Gen. For., M.K.T. Muskogee, Okla., (Chairman); H. R. Clarke, engr. m.w., C.B. & Q., Chicago; F. J. Liston, rdm., C.P., Montreal, Que.; E. D. Bentz, rdm., C. & N.W., Fremont, Neb.; H. B. Kirby, cost engr., C. & O., Richmond, Va.; B. M. Bennet, supvr., Ann Arbor, Owosso, Mich.; H. W. Stetson. gen. supvr., Me. Cent., Portland, Me.; C. F. Allen, rdm., C.M.St.P. & P., Sturtevant, Wis.; R. J. Yost, rdm., A.T. & S.F., Chillicothe, Ill.; J. B. Kelly, gen. rdm.. Soo Line, Minneapolis, Minn.; W. H. Haggerty, supvr., N.Y. N.H. & H., New Rochelle, N.Y.; W. T. Eldridge, supvr.. I.C., Vicksburg, Miss.; F. J. Meyer, asst. engr., N.Y.O. & W., Middletown, N.Y.

Committee No. 2—The Distribution and Handling of Ties from the Treating Plant or Storage Yard to the Point of Use: E. L. Banion, rdm., A.T. & S.F., Independence, Kan. (Chairman); G. L. Griggs, rdm., C.B. & Q., Centralia, Ill.; J. P. Davis, supvr., C.C.C. & St. L., Harrisburg, Ill.; Wm. Anderson, rdm., U.P., Montpelier, Idaho; R. E. Meyer, rdm., C. & N.W., Wall Lake, Iowa; J. M. Miller, supvr., West. Md., Westminster, Md.; W. H. Sparks, gen. insp. track, C. & O., Russell, Ky.; W. L. Spyres, rdm., K.C.S, Heavener, Okla.; W. A. Wehner, rdm., S.P., Lake Charles, La.; E. L. Farmer, rdm., St.L.-S.. W., Lewisville, Ark.; W. H. Jones, rdm., A.T. & S.F., Chillicothe, Ill.; S. Payson, rdm., St.L.-S.F., Enid, Okla.; E. C. Buhrer, supv., N.Y.C., Kenton, Ohio.

Committee No. 3—The Maintenance of Tracks in Terminals—Organization, Materials and Methods: A. H. Peterson, rdm., C.M.St.P. & P., Chicago (Chairman); F. H. Masters, asst. ch. engr., E.J. & E., Joliet, Ill.; J. P. Corcoran, rdm., Alton, Bloomington, Ill.; L. M. Denney, supvr., C.C.C. & St. L., Indianapolis, Ind; R. H. Carter, supvr., I.C., Chicago; R. Hurlburt, rdm., C.B. & Q., Dakota City, Neb.; W. Francis, rdm., St.L.-S.W., Waco, Tex.; J. A. Roland, rdm., (retired), C. & N.W., Missouri Valley, Iowa; H. M. Smith, rdm., N. & W., Eckman, W. Va.; C. T. Mulcahy, rdm., S.P., Nieland, Cal.; W. C. Peters, rdm., A.T. & S.F., Wichita, Kan.; J. F. Talbot, supvr., B. & M., Boston, Mass.; P. F. Muller, rdm., C. & W.I., Chicago; J. C. Runyon, supvr., C. & O., Covington, Ky.

Committee No. 4—Ballasting and Resurfacing Track Equipment, Organization and Methods: J. J. Clutz, supvr., Penna., Trenton, N.J. (Chairman); P. J. McAndrews, rdm., C. & N.W., Sterling, Ill.; J. A. Spurlock, rdm., M-K-T., Franklin, Mo.; E. L. Potarf, dist. engr. m.w., C.B. & Q., Omaha, Neb.; H. S. Talman, supvr., C. & O., Thurmond, W. Va.; J. H. Dunn, rdm., N.Y.C. & St.L., Fort Wayne, Ind.; G. L. Sitton, ch. engr. m.w., Southern, Charlotte. N.C.; A. G. Reese, rdm., C.B. & Q., Trinidad, Colo.; G. E. Kessler, rdm., S.P., Richland, Tex.; G. B. Hickok, rdm., A.T. & S.F., Lubbock, Tex.; C. A. Geiger, supvr., N.Y.C., Columbus, Ohio; L. J. Drumeller, div. engr., C. & O., Hinton, W. Va.; E. E. Crowley, roadmaster, D. & H., Oneonto, N.Y.

Committee No. 5—The Maintenance, Reclamation and Repair of Frogs, Switches, Railroad Crossings and Other Track Material and the Economic Limitations of Such Practice: Walter Constance, supvr., C. & O., Barboursville, W. Va., (Chairman); A. B. Chaney, div. engr., M.P., Poplar Bluff, Mo.; J. Morgan, supvr., C. of Ga., Leeds, Ala.; Z. M. Briggs, asst. engr., Penna., Pittsburgh, Pa.; M. Donahoe, div. engr., Alton, Bloomington, Ill.; O. R. McIlheny, Tenn. Coal & Iron Co., Ensley, Ala.; F. Ivers, gen. rdm., O.W.R. & N.Co., Pendleton, Ore.; L. F. Barrs, rdm., S.A.L., Hamlet, N.C.; J. Haas, rdm., A.T. & S.F., Woodward, Okla.; H. A. Halverson, rdm., C. & N.W., Wall Lake, Iowa; C. F. Edwards, cost engr., C. & O., Columbus, Ohio; T. Thompson, rdm., A. T. & S.F., Joliet, Ill.

Panama Canal Traffic Shows Increase in 1934

Commercial traffic through the Panama canal during the fiscal year ended June 30, 1934, was considerably greater than in either of the two preceding years, according to the annual report of the Secretary of War. Comparisons with the fiscal year 1933 show that in 1934 there were increases of 23 per cent in the number of transits, 25 per cent in the net tonnage of vessels, 36 per cent in the tonnage of cargo carried through the canal, and about 23 per cent in the tolls collected. The total net revenues collected by the Panama canal in 1934 amounted to $18,177,103, an increase of $6,000,000, or about 50 per cent over 1933. Vessels of the United States carried 46.8 per cent of all the cargo passing through the canal, while 53.2 per cent was carried by foreign ships, those of Great Britain carrying 21 per cent, Norway 8.4 per cent, Japan 6.1 per cent and the balance scattered.

Personal Mention

General

F. M. Rutter, assistant district engineer of the British Columbia district of the Canadian Pacific, with headquarters at Vancouver, B.C., has been appointed assistant to the assistant general manager, with the same headquarters. Mr. Rutter will continue to discharge the duties of assistant district engineer.

Engineering

R. C. Dunlay, a roadmaster on the Missouri-Kansas-Texas, with headquarters at Parsons, Kan., has been promoted to district engineer with the same headquarters, succeeding **W. W. Marshall,** who has been appointed roadmaster-switch inspector for the system.

J. H. Morgan, acting engineer maintenance of way of the Florida East Coast, with headquarters at St. Augustine, Fla., has been appointed engineer maintenance of way at that point. A sketch of Mr. Morgan's railway career was presented in the September, 1934, issue of **Railway Engineering and Maintenance,** following his appointment as acting engineer maintenance of way, to succeed the late **W. G. Brown.**

Following the consolidation of the Kansas and St. Louis divisions of the Chicago, Rock Island & Pacific, to form the Kansas-St. Louis division, **C. C. Cunningham,** division engineer of the Kansas division, has had his jurisdiction extended to include the St. Louis division, and his headquarters have been moved from Herington, Kan., to Kansas City, Mo. **F. Nugent,** trainmaster at Manley, Iowa, has been appointed division engineer of the Cedar Rapids-Dakota division with headquarters at Cedar Rapids, Iowa, succeeding **W. E. Heimerdinger,** who has been appointed roadmaster at Haileyville, Okla., as noted elsewhere in this issue.

H. B. Lincoln, general track inspector on the New York Central, with headquarters at New York, has been promoted to division engineer on the Pennsylvania division with headquarters at Jersey Shore, Pa., to succeed **H. I. Hoag,** who has been transferred to the Buffalo division, with headquarters at Buffalo, N.Y., to take the place of **B. M. McDonald,** whose death on December 31, 1934, is noted elsewhere in these columns. Mr. Lincoln was born on January 4, 1889, at Syracuse, N.Y., and received his higher education at Syracuse university. He began his railroad career on July 22, 1905, as a laborer on the New York Central, and on July 13, 1906, he became a chainman, with headquarters at Port Byron, N.Y. On June 19, 1909, Mr. Lincoln was promoted to assistant foreman with headquarters at Syracuse, and on May 15, 1912, he was further advanced to instrumentman with the same headquarters. On June 16, 1913, he was promoted to assistant supervisor of track at Syracuse and on November 24, 1924, he was promoted to supervisor of track with headquarters at Carthage, N.Y. On August 1, 1929, Mr. Lincoln was transferred to Weehawken, N.J., and on March 16, 1933, he was advanced to general track inspector, which position he was holding at the time of his recent promotion to division engineer.

Edward E. Young, whose appointment as division engineer of the Hannibal division of the Chicago, Burlington & Quincy, with headquarters at Hannibal, Mo., was noted in the January issue, was born on October 13, 1879, at Panora, Iowa. He was educated in civil engineering at Highland Park college, Des Moines, Iowa, and entered railway service in September, 1903, as a rodman

Edward E. Young

of the Chicago, Rock Island & Pacific. Mr. Young left this company in the spring of 1904 and went with the City of Des Moines as an instrumentman, returning to the Rock Island in the fall of the same year. On August 1, 1905, he entered the service of the Burlington as an instrumentman at Burlington, Iowa. In 1915, he was advanced to office engineer and in 1921 he was appointed to the position of assistant engineer.

Track

W. L. Spyres, roadmaster on the Kansas City Southern, with headquarters at De Quincy, La., has been transferred to Heavener, Okla.

G. Talbot, a track foreman on the Canadian Pacific, with headquarters at Bentley, Alta., has been appointed roadmaster with headquarters at Consul, Sask., to succeed **J. P. Rogiani,** who has been transferred to Macleod, Alta.

T. Henning, track foreman on the Michigan Central, with headquarters at Mason, Mich., has been promoted to roadmaster at Lansing, Mich., succeeding **A. O. Weidenthal,** who has been transferred to Battle Creek, Mich., replacing **W. Peterson,** resigned.

Nelson Astle, section foreman and extra gang foreman on the Canadian National, has been appointed acting roadmaster with headquarters at Napadogan, N.B., succeeding **I. Theriault,** who has been transferred to St. Leonard, N.B., where he replaces **George Gallant,** who has retired.

W. E. Heimerdinger, division engineer of the Cedar Rapids-Dakota division of the Chicago, Rock Island & Pacific, with headquarters at Cedar Rapids, Iowa, has been appointed roadmaster with headquarters at Haileyville, Okla., to succeed **James Bolton,** whose death on December 12 was noted in the January issue.

E. P. Fitzgerald, acting roadmaster on the Gulf Coast Lines, has been appointed roadmaster with headquarters at Bay City, Tex., succeeding **A. C. Soechting,** who has been transferred to the Taylor district of the International-Great Northern, with headquarters at Palestine, Tex. Mr. Soechting replaces **B. C. Vanover,** who has been transferred to the Trinity district of the International-Great Northern, with headquarters as before at Palestine, succeeding **S. C. Grizzle,** deceased. The Gulf Coast Lines and International-Great Northern are units of the Missouri Pacific Lines.

V. L. Kapple, formerly an assistant roadmaster on the Chicago, Burlington & Quincy, has been appointed roadmaster on the Ottumwa division, with headquarters at Burlington, Iowa, succeeding **C. E. Anderson,** whose death on December 19 was noted in the January issue. **M. P. Bogich,** also a track supervisor, has been promoted to roadmaster on the McCook division, with headquarters at Orleans, Neb., succeeding **T. V. Ross,** who has been transferred to Denver, Colo., on the same division, succeeding **H. W. Freeman,** who has been assigned to other duties.

R. W. Worthington, general foreman on the Erie at Port Jervis, N.Y., has been promoted to supervisor on the Wyoming division, at Dunmore, Pa., to succeed **L. H. Judd,** who has been transferred to Campbell Hall, N.Y., to succeed **W. H. Wahl,** retired. **L. Rossman,** general foreman on the Erie, with headquarters at Hornell, N.Y., has been promoted to supervisor on the New York, Susquehanna & Western Lines of the Erie, with headquarters at Butler, N.J., succeeding **John Lyman,** who has been appointed general foreman.

Mr. Rossman was born on August 8, 1904, at Philadelphia, Pa., and was graduated from the Pennsylvania State College in June, 1928, with the degree of C.E. He entered railway service on April 1, 1929, as a transit in the maintenance of way department of the Erie, with headquarters at Salamanca, N.Y., and was subsequently made a rodman. Later he became a trackman and was appointed assistant foreman on May 15, 1930. Later in the same year he again joined the engineering forces and became a transitman, only again to become assistant foreman at Hornell N.Y., upon the completion of specific engineering work. On July 1, 1932, he become chief of curve-lining corps on the Delaware and Susquehanna divisions, and on February 1, 1934, was made chief of the engineering corps at Hornell. He was promoted to general foreman of the Hornell yards on

April 1, 1934, which position he was holding at the time of his recent promotion.

Ralph R. Smith, assistant supervisor of track on the New York Central, with headquarters at Buffalo, N.Y., has been promoted to supervisor of track, with headquarters at Richland, N.Y., succeeding **G. T. Donahue,** who has been transferred to the Electric division, with headquarters at New York. Mr. Donahue succeeds **George Baerthlein,** who has been promoted to general track inspector, Lines Buffalo and East, with headquarters at New York, to take the place of **H. B. Lincoln,** whose promotion to division engineer at Jersey Shore, Pa., is noted elsewhere in these columns. **D. E. Fuller,** a transitman at Syracuse, N.Y., has been promoted to assistant supervisor of track at Buffalo, to succeed Mr. Smith.

Mr. Smith was born on April 1, 1895, at Buffalo, N.Y., and received his higher education at the University of Rochester and the University of Syracuse, receiving the degree of C.E. He began his railroad career on May 3, 1920, as chainman on the New York Central, with headquarters at Buffalo, N.Y., and on October 16, 1920, he was promoted to rodman at the same point. On October 1, 1921, he became a transitman at Buffalo, and on June 1, 1925, he was promoted to assistant supervisor of track at Charlotte, N.Y. On June 1, 1927, Mr. Smith was transferred to Buffalo, where he was located at the time of his recent promotion to supervisor.

Mr. Baerthlein was born on May 27, 1880, at Guttenberg, N.J., and was graduated from Cooper Institute with the degree of C.E. He began his railroad career on September 15, 1907, as a chainman on the New York Central, with headquarters at Weehawken, N.J., and on August 1, 1908, he was promoted to rodman at the same point. On September 1, 1910, he was further advanced to transitman at Weehawken and on January 15, 1912, he was appointed a draftsman at New York. On June 16, 1916, Mr. Baerthlein was promoted to assistant supervisor, with headquarters at Pawling, N.Y., and on May 1, 1923, he was promoted to assistant engineer of track, with headquarters at New York. On December 1, 1925, he was appointed assistant division engineer, with the same headquarters, and on October 1, 1927, he became supervisor of track, at Remsen, N.Y. On April 16, 1929 he was transferred to Kingston, N.Y., and on May 1, 1931, he was transferred to New York, where he remained until his recent promotion to general track inspector.

Obituary

J. Ryan, Jr., supervisor of track on the Chicago & Eastern Illinois, with headquarters at Watseka, Ill., died on January 17.

Charles Lapham, assistant engineer on the Chicago, Milwaukee, St. Paul & Pacific, with headquarters at Milwaukee, Wis., and formerly district engineer at the same point, died suddenly on January 8. Mr. Lapham had been connected with the Milwaukee continuously for more than 55 years. He was born on February 10, 1857, and received his engineering education at the University of Wisconsin. He entered the service of the Milwaukee in 1879 as a rodman and was advanced through various positions in the engineering department to that of district engineer at Milwaukee in 1910. In 1919 Mr. Lapham was assigned to special duties and given the title of assistant engineer, which he held until his death.

Charles H. Stein, assistant to the president of the Central of New Jersey, with headquarters at New York, and formerly engineer maintenance of way of this railroad, died on January 3 at Muhlenberg hospital, Plainfield, N.J., after a short illness. Mr. Stein was born in Baltimore, Md., on July 23, 1871, and was graduated from Baltimore City college in June 1889. He entered railroad service in 1889 with the Western Maryland as an instrumentman and assistant engineer. Mr. Stein served as assistant roadmaster with this company from 1893 to 1903, and from the latter date until 1907 he was, successively, assistant supervisor and supervisor for the Philadelphia & Reading (now Reading). At the end of this period Mr. Stein went with the Central of New Jersey as engineer maintenance of way and in 1914 he became superintendent. He was appointed assistant to the general manager for the Philadelphia & Reading and the Central of New Jersey in 1918 and in 1920 he was appointed assistant to the president of the latter company. From 1922 until 1926 Mr. Stein was general manager of the Central of New Jersey, being appointed assistant to the senior vice-president in the latter year. Later in the same year he was appointed assistant to the president.

Charles H. Stein

B. M. McDonald, division engineer of the Buffalo division of the New York Central, with headquarters at Buffalo, N.Y., died on December 31, 1934. Mr. McDonald was born on January 17, 1872, at Springfield, Mass., and was graduated from Lehigh university with the degree of C.E. He began his railroad career on June 1, 1899, as an assistant roadmaster on the New York Central, and on July 1, 1901, he was appointed assistant supervisor of track with headquarters at Utica, N.Y. On June 1, 1902, Mr. McDonald was promoted to supervisor of track, with headquarters at DeKalb Junction, N.Y., and on July 1, 1905, was advanced to division engineer of the Pennsylvania division, with headquarters at Jersey Shore, Pa. He was transferred to the Buffalo division on April 1, 1911, with headquarters at Buffalo.

C. W. Hilderbrant, roadmaster on the Northern Pacific, with headquarters at Centralia, Wash., died suddenly on January 9.

Thomas E. Hill, superintendent of the Kentucky division of the Illinois Central, with headquarters at Paducah, Ky., and formerly a roadmaster on this road, died on January 7, in a hospital at Paducah, following a heart attack.

David W. Lum, who retired in 1931 as special engineer of valuation for the Southern, with headquarters at Washington, D.C., died at his home in Washington on December 27, of heart disease. Mr. Lum was born in March, 1855, at Newark, N.J. He entered railway service in 1872, serving with various roads, including the Pennsylvania, the Delaware, Lackawanna & Western, the Erie, the Chesapeake & Ohio and the Kentucky Central (now part of the Louisville & Nashville) until 1885. In that year he entered the service of the East Tennessee, Virginia & Georgia (now part of the Southern) as principal assistant engineer, later being advanced to chief engineer. Later he was appointed superintendent of tracks, bridges and buildings of the Southern, then serving successively as assistant general superintendent of maintenance, engineer of bridges and buildings and chief engineer maintenance of way and structures until 1911. In that year Mr. Lum resigned to enter private practice as a consulting engineer, returning to the Southern as special engineer in charge of valuation in 1913. He retired in February, 1931.

Francis Lee Stuart, former chief engineer for the Baltimore & Ohio and of the Erie, died on January 15 at Essex Falls, N.J., of heart disease, at the age of 68. Mr. Stuart was born at Camden, S.C., on December 3, 1866, and after graduating from the Emerson Institute at Washington, D.C., in 1884, entered the service of the Baltimore & Ohio in the office of the chief engineer. He served as a rodman, levelman, transitman and resident engineer for this company until 1887. In 1889, after engaging in general engineering work for two years. Mr. Stuart became resident engineer in charge of the construction of the Briarfield, Blocton & Birmingham (now Southern) later being appointed engineer maintenance of way. Mr. Stuart returned to the Baltimore & Ohio in 1892 as resident engineer, becoming supervisor in charge of construction in 1894. In 1895 he resigned to engage in other work. In 1900, after serving for three years in engineering capacities with the Nicaragua and Isthmian canal commission, Mr. Stuart returned to the B.&O. as assistant engineer and engineer of surveys. From

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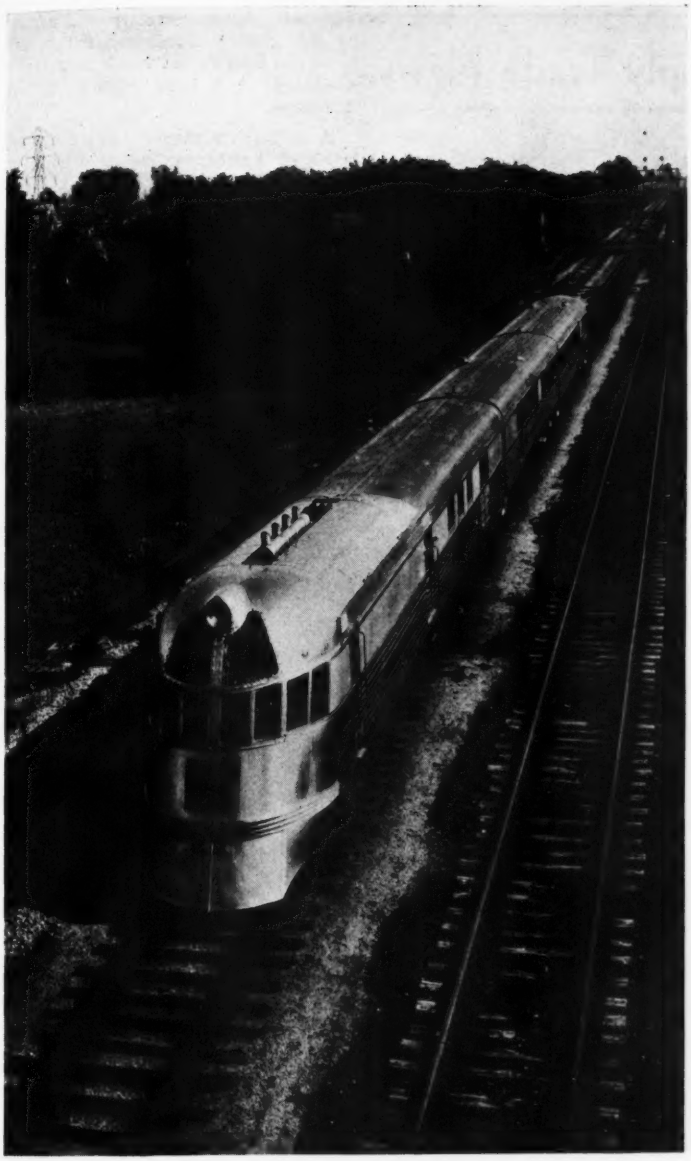
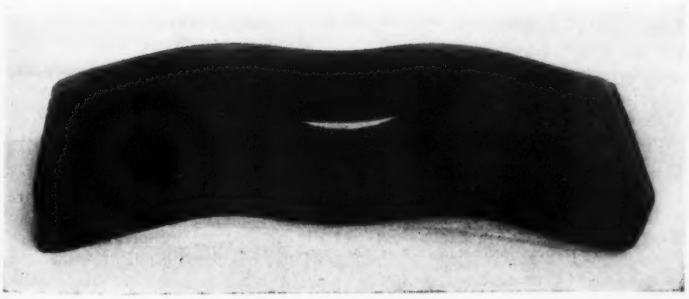


The Zephyr of the Burlington Route

TWO RECORD BREAKERS

The STREAMLINE ZEPHYR of the CHICAGO, BURLINGTON & QUINCY R. R. not only is breaking speed records but is establishing a new high in patronage on its run between LINCOLN, OMAHA and KANSAS CITY.



Verona Triflex Spring

VERONA TRIFLEX SPRINGS for Track Bolts with A SPRING REACTION 100% GREATER THAN A. R. E. A. SPECIFICATIONS and affording A DEFINITE MEANS OF ESTABLISHING EQUAL BOLT TENSION is breaking Speed Records in its adoption by the Railroads of the United States.

WOODINGS-VERONA TOOL WORKS

VERONA, PA.

1905 to 1910 he served as chief engineer for the Erie, then returning to the B. &O. in the same capacity. In 1915 Mr. Stuart resigned from railroad service to enter consulting practice and during the World War he served the government in a number of important capacities. After the close of the war he re-entered private practice.

Andrew M. Clough, who served as president of the Roadmasters' and Maintenance of Way Association in 1912, and who retired in 1932 as supervisor of track on the New York Central, with headquarters at Batavia, N.Y., died on January 10, following an illness induced by a stroke on October 29, 1934. Mr. Clough was born in Scotland on September 13, 1862, and was educated at Willfield academy and the University of Edinburgh. Coming to this country as a young man, he entered railway service on August 15, 1883, as a laborer on the Michigan Central, being subsequently promoted through the positions of track foreman, extra gang foreman and roadmaster. On October 15, 1893, Mr. Clough left the Michigan Central to enter the service of the New York Central & Hud-

Andrew M. Clough

son River (now part of the N.Y.C.) as a yard foreman with headquarters at Niagara Falls, N.Y. On December 1 of the following year he was appointed construction foreman at Suspension Bridge, N.Y., being advanced to assistant supervisor at Batavia on April 1, 1895, later holding the same position at Hudson, N. Y. He was promoted to supervisor of track at Kingston, N.Y., on April 15, 1900, being transferred to Batavia on December 1 of the same year. From July to December, 1902, Mr. Clough held the position of general track inspector with jurisdiction over all divisions east of Buffalo, N.Y., again assuming the position of supervisor of track at Batavia at the end of this period. During the following eight years Mr. Clough alternated between the positions of supervisor of construction at various points and supervisor of track at Batavia, holding the latter position continuously from December 1, 1910, until his retirement in 1932. For many years Mr. Clough was a consistent winner of first place in the annual track inspection of his road.

Supply Trade News

General

Effective January 1, the name of the **Ohio Power Shovel Company,** a wholly owned subsidiary of the **Lima Locomotive Works, Inc.,** Lima, Ohio, was changed to **Lima Locomotive Works, Inc., Shovel and Crane Division.**

Personal

William G. Mathias, who retired as assistant vice-president of the Tennessee Coal, Iron & Railroad Company in 1929, died in St. Petersburg, Fla., on December 18.

Col. E. A. Deeds of New York and Dayton, Ohio, was elected a director of **The American Rolling Mill Company** at a meeting of the board of directors held at the office of the company in Middletown, Ohio, on January 7, 1935. This fills the vacancy occurring through the death of **James P. Orr** of Cincinnati.

Lyle I. Martin, formerly connected with the **Pettibone Mulliken Company,** and more recently with the engineering department of the Chicago & North Western, has become associated with the **Morden Frog & Crossing Works** in the engineering, service and sales department, with headquarters at Chicago.

C. G. Landes, Columbus, Ohio, has been appointed distributor of Loadmasters in the central portion of Ohio for the **Bucyrus-Erie Company,** South Milwaukee, Wis. **The Collier Tractor & Equipment Company** has been appointed Loadmaster distributor for the northern and western sections of Nevada, and the northeastern portion of California.

J. H. Larmonth, who had been manager of The Rail Joint Company of Canada, Ltd., Montreal, Canada, for many years, died on January 3, at the age of 63. Mr. Larmonth was graduated from McGill University in 1894 with the degree of bachelor of science and then for about a year was connected with the mechanical department of the Grand Trunk Railway. He subsequently served with a number of industrial companies and in charge of street railways. During the war he was connected with the Imperial Munitions Board as superintendent of the steel department. In 1922, he became interested in the railway supply business and represented a number of companies, later becoming president of Engineering Materials, Ltd.

F. C. Harper, secretary and treasurer of the **American Sheet & Tin Plate Company,** Pittsburgh, Pa., a subsidiary of the **United States Steel Corporation,** has been elected vice-president and general manager of sales. **J. I. Andrews,** vice-president, has retired; **F. M. Fuller,** general manager of sales, has been appointed assistant to the president; **Percy Cooke,** assistant secretary and assistant treasurer, has been elected secretary and assistant treasurer; **M. L. Gardner,** assistant treasurer, has been elected treasurer and **L. K. Hitchings** has been elected assistant treasurer.

A. B. Jacobus, manager of general scale sales of **Fairbanks, Morse & Co.,** with headquarters at Chicago, has been promoted to general manager of **E. & T. Fairbanks & Co.,** with headquarters at St. Johnsbury, Vt., and has been succeeded by **George C. Worthley,** manager of the scale department in the New York branch.

Griswold Price, assistant manager of sales of the St. Louis district of the **Illinois Steel Company,** the **Carnegie Steel Company,** and the **Tennessee Coal,**

Griswold Price

Iron & Railroad Company, has been promoted to manager of sales for these companies, with headquarters as before at St. Louis, Mo. He graduated from Northwestern university in 1919 and entered the employ of the Illinois Steel Company in July of that year. After spending a year at the Gary, Ind., and South Chicago plants of this company, he was employed in the Chicago district sales office and the general sales department from July, 1920, to June 1, 1931. On the latter date he was appointed assistant manager of sales of the St. Louis district, which position he held until his recent promotion.

Trade Publication

"What About Your Roofs?"—This is the title of a booklet issued by Johns-Manville, New York, which deals with many of the important problems involved in roof construction and maintenance. Among the subjects given consideration are the importance of not delaying needed roof repairs; the physical properties and characteristics of various types of build-up roofing materials; and the importance of expert application and inspection in connection with roof construction work. Attention is also devoted to roof insulation and its effect in reducing fuel costs, and a new complete roof unit, which combines a steel deck, insulation and waterproofing, all in one unit structure, is described.

Added Safety for High-Speed Trains

A COMPLETE CHECK ON SWITCH POINTS

WITH DISTANCE SIGNAL WARNING

FIVE POINTS OF SAFETY

1 Danger is indicated the instant the latch holding the switch-stand lever is lifted.

2 Danger is indicated as soon as the switch points are moved more than ⅛ inch from their main-line position, and danger continues to be indicated until the switch points are restored and locked in the main-line position.

3 Danger is indicated if the switch is run through, leaving the switch points open ⅛ inch or more.

4 Safety is indicated only when switch points are in correct position for safe main-line operation, and the switch-stand lever locked.

5 Switch points protected by a positive safety point-lock automatically operated by the switch stand.

WITH the new Bethlehem Five-Point Safety Switch Control, a switch is completely and positively safeguarded. This device, known as the Bethlehem Positive Signal Stand, besides serving as a switch stand, throws a derailer in a turnout, operates a distance signal indication and also embodies a facing-point lock and a switch-point detector.

This new Bethlehem development gives warning of any lurking danger at the switch, even when it is of such a nature that the target indication is clear. A switch may have been run through and the points left open without changing the target position. The Bethlehem Positive Signal Stand warns of this, or any other derangement leaving the points open ⅛ inch or more.

With the Bethlehem Positive Signal Stand, any switch in track-circuit territory can be made as safe as though controlled from an interlocking plant. The safety of high-speed train operation is substantially increased.

Write for complete detailed information on this new development.

BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY

GENERAL OFFICES: BETHLEHEM, PA.

Practical Books that will Help Maintenance Men Do Better Work

Simplified Curve and Switch Work

By W. F. RENCH

Formerly Supervisor on the Pennsylvania

This little book has practically revolutionized curve and switch calculation practice since its appearance 12 years ago. The proved accuracy of its methods has caused them to be adopted as standard practice on many roads.

Complex algebraic and geometric calculations are reduced to their simplest form and as nearly as possible to terms of simple arithmetic. Application of these calculations to the actual job is made plain by brief explanations. Drawings further clarify the subject and make the meaning of the text unmistakable. Tables of dimensions are a further help to the track foreman.

Short cut formulae are featured. String lining and tape line layouts are fully explained. While retaining practically all of the rules and principles which have been time tested in previous editions, changes have been made in several detailed features to correspond to improved designs. A flexible binding makes the new edition more convenient to slip in the pocket and carry on the job.

213 pages, 24 illustrations, 5x7, cloth, $2.00

for engineers—

Track and Turnout Engineering

By C. M. KURTZ

Engineer, Southern Pacific Company

This new handbook for location, construction and maintenance of way engineers, transitmen and draftsmen, gives practical mathematical treatment of track layout and other problems. These are **fully exemplified** and worked out in detail, and illustrated with drawings of accepted designs for fixtures and track layouts. It contains original as well as a complete set of standard railway engineering handbook tables. All computing problems which may arise in track engineering are thoroughly treated by an engineer of 25 years' experience.

257 pages, 116 illustrations, 33 tables, flexible binding, 5x7 inches, $5.00

for roadmasters—

Roadway and Track

By W. F. RENCH

A valuable compilation of practical information on the solution of problems of construction and maintenance of roadbed and track. The practice described is largely that of the *Pennsylvania* but methods adopted as standard on other roads are also given. Drawings and photographs supplement the text and there is a complete index.

Second edition, 226 pages, 44 illustrations, cloth, 6x9, $2.00

for section foremen—

Practical Trackwork

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An up-to-date handbook giving expert information on the design, fabrication and installation of standard trackwork. Thoroughly describes switch stands, switches, frogs, crossings and slip switches.

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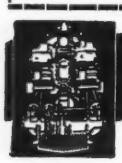

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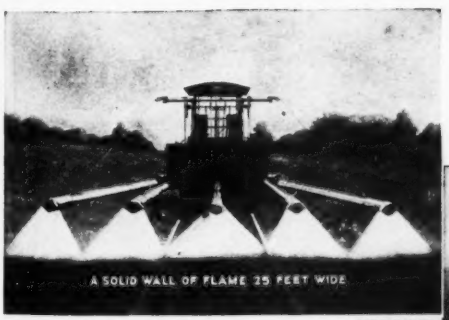

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The Giant "Octopus"

Woolery Control-Type Railway Weed Burner built in 3 and 5-burner types. The widest burning and most flexible machines yet produced. Outside burners may be swung in or out, up or down at the will of the operator while the machine is in operation. Each burner under separate and positive control. The long side arms may be swung out to burn to a width of 45 feet to burn out ditches and assure good drainage.

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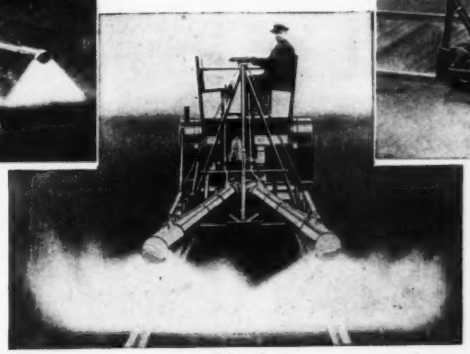

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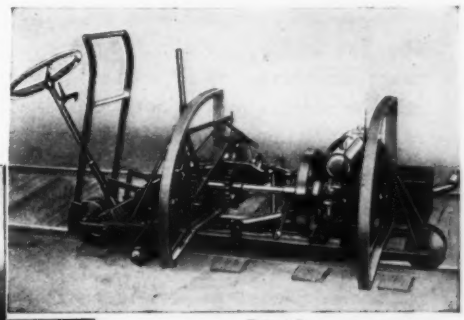
Many Roads are using them for snow melting with remarkable results.



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Read This Working Report From One of the Large Northwest Railroads:

Date	Hour Operation	Hours Helper	Number Joints	Gal. Gas Used
Oct. 12-29	8	8	210	3
Oct. 13-29	8	8	210	3
Oct. 14-29	8	8	215	3
Oct. 15-29	8	8	220	3
Oct. 16-29	8	8	220	3
Oct. 17-29	8	8	230	3

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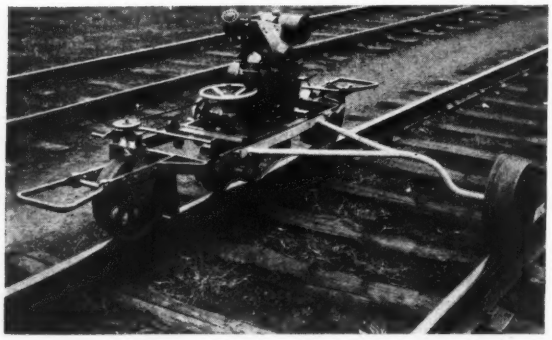

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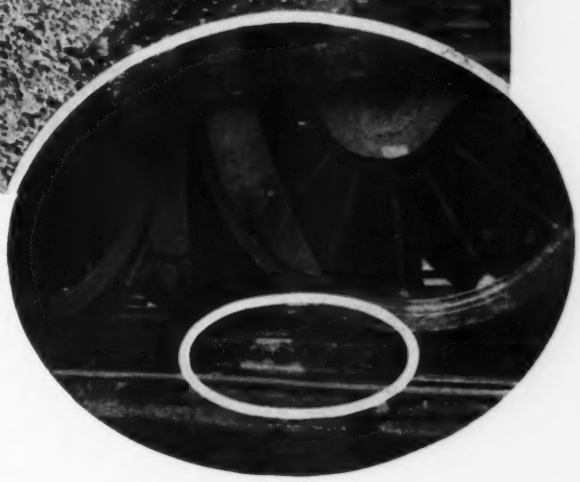

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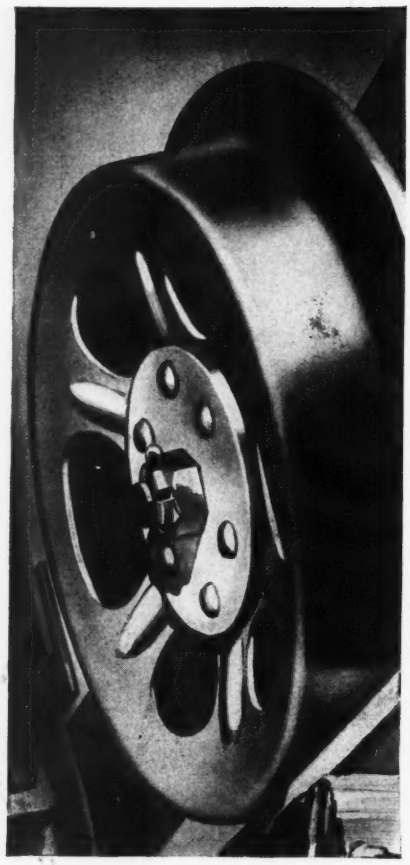

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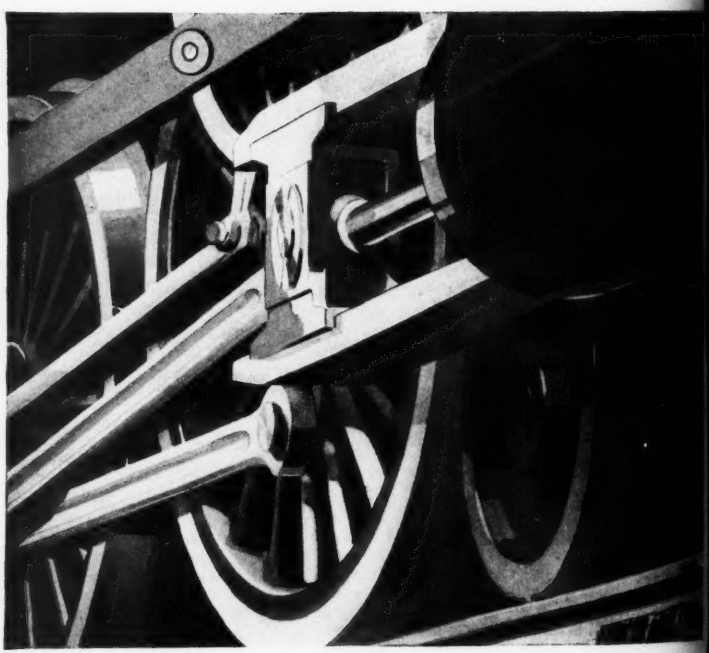

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